Mining Journal

ISSUED WEEKLY

VOLUME C

July 1 to December 31, 1915

HILL PUBLISHING CO.
HILL BUILDING
10TH AVENUE AT 36TH STREET
NEW YORK

Engineering and Mining Journal

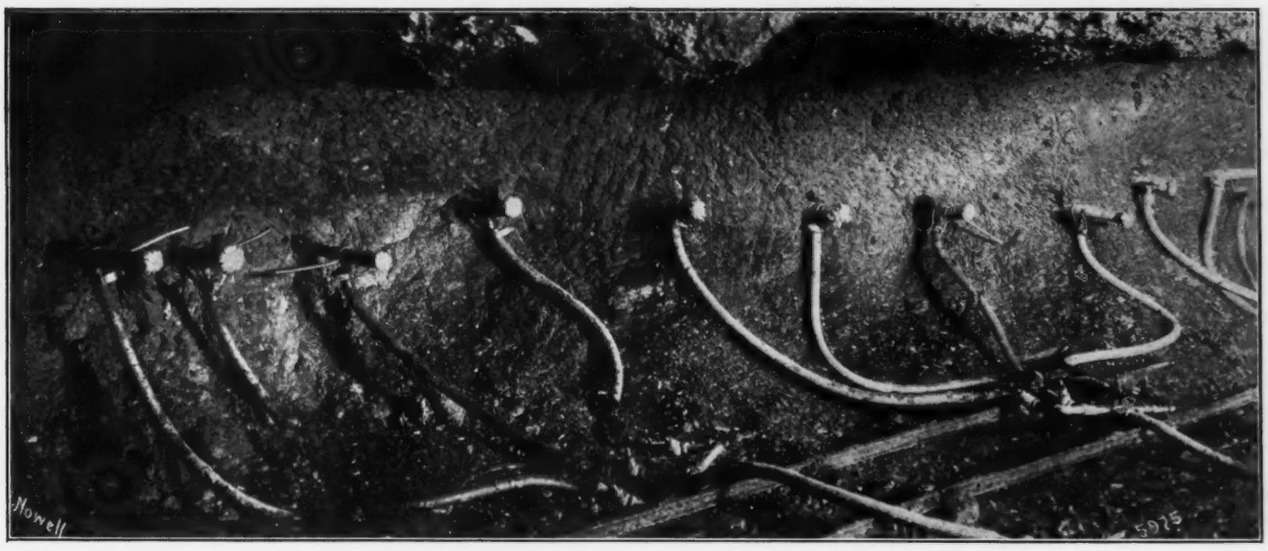
VOLUME 100 JULY 3, 1915 NUMBER 1

Thawing Methods at Fairbanks

By Hubert I. Ellis*

SYNOPSIS—Thawing the frozen paystreak is one of the most important details of mining at Fairbanks. Wood fires were formerly used, but had obvious disadvantages. The efficiency of steampipe methods was accidentally discovered in principle, and has been developed into the only feasible procedure. Full description of principles and practice is given.

After the "opening up," or development, of a typical Fairbanks placer mine, the next step, leaving out of consideration for the present the washing plant, is putting in the first "thaw." Since thawing the permanently frozen material of the paystreak is one of the most important and expensive items entering into the cost of mining—averaging about 20% of the total—the history and development of the steam point will be briefly discussed.



A Battery of Steam Points at Work in the Gravel

Thawing with Wood Fires

Before the discovery of gold at Dawson there had been considerable mining in the great region tributary to the Yukon, notably at Circle, Koyukuk, and on the Stewart River. Where the heat of the sun was not available for thawing, wood fires were used. The slow, easy-going methods of the old timers did not meet with the approval of the eager Dawson stampeders, however, and they cast about for some more efficient scheme for removing the frost from the gravel.

The first attempt to thaw underground, otherwise than with wood fires, seems to have been made on Bonanza Creek in 1898. Pipe boilers of 10-hp. capacity were used to generate steam for siphons and injectors, by means of which warm water was played against the frozen face. The larger rocks were picked loose as fast as they thawed from the matrix and were thrown back to serve as support for the roof. Subsequently pipe boilers of 20 and 25 hp. were introduced, and pulsometer pumps were used to force the water against the face.

This method was applied especially to bench deposits opened by adit, and was used to some extent during winter. The gravel was thawed at night and the rocks removed, and during the day the fine gravel was shoveled into 6-in. sluice boxes supplied with water by the pump used at night for thawing. The tailings were discharged into a box outside the mine, from which they were shoveled into wheelbarrows and wheeled to the edge of the dump. Water, being a scarce article on the benches both in winter and in summer, was used over and over. In driving tunnels with the pulsometer pump an advance of 8 to 10 ft. per day was easily made. The pump as a means of thawing did not give satisfaction, however, chiefly on account of the unavoidable thawing and sloughing of the roof.

Discovery of the Steam-Point Principle

The principle of the steam point was discovered by accident. An engineer noted that the exhaust of the engine he was using had thawed a hole in the surface muck with

*4352 Ninth Ave., N. E., Seattle, Wash.

which it came in contact. This aroused his curiosity and led to casual experiments, which proved that live steam was an effective agency for thawing the muck. The big problem, however, was to thaw the gravel, since the muck handled was comparatively insignificant in amount and could be removed by picking. The inference was obvious that steam, if it would thaw muck, which is more than 50% ice, would likewise thaw gravel, in which the proportion of ice is much less. But here arose another difficulty—that of getting the steam to the interior of the deposit of gravel to be thawed. Since ordinary pipe could not be driven into such resistant material, the first method that suggested itself was to drill the holes with ordinary hand steel and insert the steampipe afterward; but the prohibitive cost of labor prevented serious consideration of this possibility. Then it was remembered that, although frozen gravel was as resistant as concrete, a pick or crowbar could be driven readily into the gravel once it was thawed, and the idea of using hollow drill steel carrying live steam followed as a logical consequence. No drill steel of this kind being at hand, there was substituted the ingenious but ineffective makeshift shown in Fig. 1. This

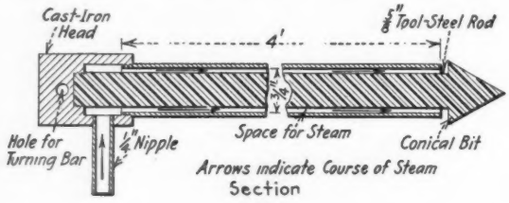


FIG.1

THE FIRST STEAM POINT

consisted of a 4-ft. iron pipe with a ⅝-in. tool-steel rod passing through the center and ending in a conical bit larger than the outside diameter of the pipe. The point had a cast-iron head with a ¼-in. nipple tapped in to admit steam to the annular space between the pipe and the rod. The conical bit cleared away the ground in front of the pipe, much as a churn-drill clears the way for the

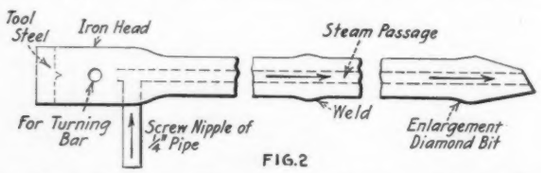


FIG.2

TWO GUN BARRELS WELDED TO MAKE A STEAM POINT

casing, except that the gravel was pushed to the side instead of being removed. This point was driven by means of a wooden mallet, and although fairly satisfactory at that time for soft ground, it could not be used successfully where driving was hard. It added further proof of the value of the principle, however, and served to pave the way for an improved tool.

The next step in the development of the steam point consisted of welding together two gun barrels, welding on an iron head and a tool-steel bit, and tapping in a ¼-in. pipe for the admission of steam (Fig. 2). This form of steam connection proved unsatisfactory under the heavy hammering to which the point was subjected, and what was known as the boiler-rivet nipple was substituted, as shown in Fig. 3. The rivet was placed and calked to prevent leakage of steam and the steam passage was drilled out afterward. In a later design the rivet was welded to the head of the point, but this was soon replaced by the modern nipple point, which is described in what follows.

The gun-barrel point having proved, in an experimental way, the value of the principle underlying the design, hydraulic pipe (XXXX) was obtained for the barrel of the point, a tool-steel bit and a rolled-steel head being welded on, as shown in Fig. 3. Hollow drill steel was later substituted for the hydraulic pipe, and it became unnecessary to weld on a tool-steel driving point. Fig. 4

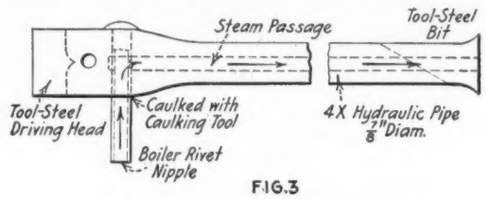


FIG.3

THE THIRD STEAM POINT

Hydraulic pipe with tool-steel bit

shows the entire modern nipple point and Fig. 6 illustrates the details of the head and nipple.

DESIGN OF STEAM CONNECTIONS

The steam connection has been the source of more trouble than all the rest of the point. Many connections have been invented and used to a greater or less extent in practice; some operators prefer one, some another. The nippleless-socket point with drop-forged connections, one type of which is shown at *A*, Fig. 5, has found a wide market in a great variety of designs. For all-around purposes, however, the nipple point has much to recommend its use. The chief objection to the yoke and other socket-type points, aside from the cost, is that the nuts constantly work loose under the hammering in driving and require frequent tightening. This takes but a moment's time, but

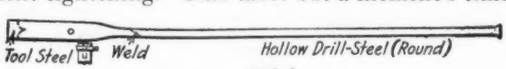


FIG.4

MODERN STEAM POINT

Hollow drill-steel barrel, cold-rolled steel head and solid-welded nipple

the threads on the yoke gradually become worn and the yoke itself frequently crystallizes and breaks. Since it is not convenient for the pointman to put on a new yoke underground, owing to the loss of time involved and the unfavorable conditions for such work, the point must be disconnected and withdrawn and another inserted. With the nipple point the only part to work loose is the clamp, and this is fastened to the point head by baling wire to prevent its coming loose suddenly and scalding the operator with hot steam. In my experience the clamp requires less attention than the nuts on the yoke of the nippleless point, and the nipple point never has to be sent to the surface on account of poor connections. The hose, further, can be disconnected from the point as easily as from the crosshead, which is not the case with the other points, and which may be important where "sweaters" are used, as described later. In the matter of cost, too, the nipple point has a great advantage, since it costs only $10 or $12, against $20 for the corresponding sizes of the others. The projecting nipple is subject to being broken by a misdirected blow from the hammer; but this is an accident that is too rare to be worth mentioning.

The points used at Dawson before the Fairbanks operators developed a slightly different and more efficient

practice were 5 and 6 ft. long. Those used at Fairbanks are 8, 10, 12, 16 and 20 ft. long. The longer the point, the heavier must be the steel required to prevent buckling and bending, the more cumbersome becomes the point with its attached hose, and the harder it is to drive. The 8-ft. length is most popular at Fairbanks at present, partly because it is easier to regulate the depth of thaw with short points; but longer points are often used in driving tunnels. In using long points the holes are started with short points, which are withdrawn to permit

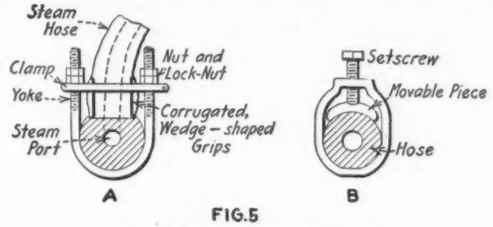


FIG.5

POINT WITHOUT NIPPLE

A, Yoke clamp. B, Screw clamp

the insertion of the long ones, and after steam has been turned on for several hours, depending on the character of the gravel, the point is drawn back about half its length to insure a uniform thaw.

DRIVING METHODS AND BITS

Wooden mallets were first used for driving, then the single jack of the quartz miner was adopted, and later double-hand hammers of 7 to 16 lb. weight were used. The heaviest hammers are too hard on the points and are used only where driving is especially hard; the 10-lb. size is most used at present. As a general thing, heavy blows will not send the point "home" any faster than lighter blows at shorter intervals, since it is impossible to drive the point faster than the gravel thaws ahead of it; as noted in the foregoing, however, this rule regarding heavy blows does not hold for exceptionally tight ground.

Three types of bits are used on the point—the "diamond," or square bit (Fig. 2), the chisel bit, such as is used on ordinary hand steel (Fig. 3), and the four-cornered, or Burleigh, bit. For easy-driving ground it has been found that the rocks are more easily pushed aside, when the surrounding material has been thawed, than drilled through, and the diamond point is preferred. Boulders too large to be pushed aside are often split wide open. When driving is harder and it is necessary actually to drill out much of the gravel the ordinary chisel bit is used, or if this is too hard to turn, as frequently happens, the four-cornered bit is employed. With the growth of the practice of driving each point to its full length before starting another, the diamond-bit, formerly almost exclusively used, is becoming a rarity on many of the creeks.

Up to the present time all driving has been done by hand. Power drills offer an attractive possibility to the operator looking to reduce his working costs, but their use has never been attended with success. In the first place, few of the mines can afford an air compressor, and drills must be run with steam, with the attendant disadvantage of the sloughing of the roof due to exhausting steam into the air. The first attempt was made on King Solomon Hill, at Dawson, with a reciprocating drill. This was a failure, and it was years before the next trial. In 1911 William Burns, of Little Eldorado Creek, Fairbanks district, installed a Chicago compressor and tried the Leyner drills. Failure was due partly to the freezing of the exhaust, no provision having been made to deliver dry air to the drill, and partly to the fact that the drill was not powerful enough to pull back through the gravel that constantly dropped around the point and wedged against the bit. A larger machine might have overcome this difficulty to some extent, but it is improbable that any type of reciprocating drill would give satisfaction. In 1913 and 1914 E. M. Keys, of Chatanika, tried out an Ingersoll-Rand BC-26 hand-hammer drill, steam-driven, with a measure of success, the principal disadvantage that developed being that two men were required to operate it. One of the large drill-manufacturing companies is now working, with every promise of success, on a rig to be handled by one man. This machine will probably be placed on the market during the current year, and it is not unlikely that hand-driving will soon be largely supplanted by machine-driving.

USE OF HOT WATER FOR DRIVING

The use of hot water for driving—steam being turned on after the points are "home"—was formerly a popular practice, and some operators still follow it. Its chief advantage is the absence of steam from "blowing back" while driving, which makes the work easier and more agreeable for the pointman and decreases the sloughing of the roof. Its disadvantages are that the water washes the sediment from the gravel and prevents effective plugging, as will appear later; that the system is very cumbersome, requiring duplication of pipe lines; and that the increased amount of water draining away from the face is an inconvenience, often causing trouble with drains, timbers, and car track. As a whole, driving with water is not to be recommended except under unusual circumstances.

The steam line is carried through the tunnels on the posts of the sets and is laid on the floor 10 ft. or more back from the face when thawing. Care must be exercised to keep it out of water at all times; otherwise there will be a large loss from condensation and sloughing from steam turned into the atmosphere. Steam lines under-

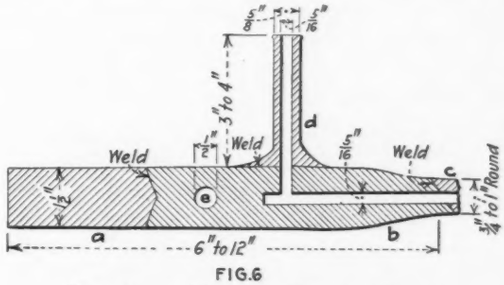


FIG.6

DETAIL OF MODERN NIPPLE POINT

Main part of head is of cold-rolled machine steel, drilled, with tool-steel head to receive blows. Nipple is welded on solid and steam passage drilled afterward

ground are never protected by any insulating material. All joints are smeared with graphite in oil when connected in order that they may be taken apart more easily. Pipe of ¾-in. diameter is most used for the various leads underground.

Fig. 7 shows a crosshead and connections to points and steam line. The point hoses are of Gorham or Goodrich manufacture, ⅝ in. in diameter, and fit over a ⅜-in. nipple on the crosshead, to which they are attached by clamps of the type shown at *B*, Fig. 5. The crosshead is

attached to the line by a ¾-in. hose. Crossheads of fittings one size smaller than those shown are sometimes used, but have no advantage other than decreased weight, and are more likely to be broken by falling rocks. All pipes are rapidly corroded and usually do not last longer than two or three years. Galvanized pipes are never employed, probably because of failure to appreciate their advantages.

Manner of Driving Steam Points

The easiest place to drive a point is neither in gravel nor in bedrock, but right where the two join, except where the bedrock is so badly decomposed as to be a sort of mush when thawed, or where there is a layer of large rocks just above the bedrock. The amount of bedrock taken up depends chiefly on the nature of it. If blocky, gold will be found to a considerable depth, but if soft, gold will not penetrate so far. The top of the bedrock is usually carried 1½ to 2 ft. above the floor. The ease of driving

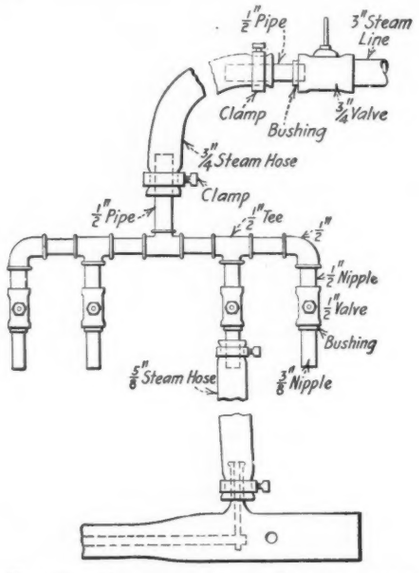


Fig. 7. Crosshead and Connections

Wheels are removed from valve stems to prevent binding by falling rock. The wheel is carried by the foreman or opened with a pair of tweezers

varies greatly with different ground, and even at the same face. At some mines, such as those on Engineer Creek, one man easily thaws the ground for 16 or more shovelers and has time to shovel waste; at the mouth of Dome and Cleary, on the other hand, six men may be required to do the same work. In easy ground two men working separately can accomplish more than two working together; but the usual practice of the district is for pointmen to work in pairs, one striking while the other rotates the point. The men change places every few minutes.

It was formerly the practice to start a number of points, usually the total number required for a single face if the supply was sufficient, and to drive them alternately as far as they would go without resistance. In this way one or two men could drive many points without the heavy hammering sometimes necessary where each point is driven alone, which is easier on the rigging and easier on the pointman. The increased use of "sweaters," with only a few points for drilling the holes, has discouraged this practice, however, and it is now usual to drive but one point at a time.

In driving, the point-hose is connected to the crosshead and the point is placed against the face at the proper height. The head is supported on a "horse," Fig. 8, or on a box, or is held across the knee by the assistant, dry gunnysacks being used for protection from the heat. A little steam is turned on and the hammerman strikes the head, gently at first, while the assistant rotates the point back and forth through an angle of 90° to 180°, depending on the type of bit used. At first much steam "blows back" around the point and fills the workings, causing the roof to slough and rendering vision difficult unless the stoped-out area is large. The point is usually so low that the hammerman must stoop to strike, and frequently he must keep his face close to the head of the point in order to see well enough to strike accurately. As the steam escapes into the atmosphere the temperature rises and there is a constant shower of gravel from the roof. Boulders of various sizes, up to a foot or more in diameter, seek with strange fatality the head of the hapless pointman as a place on which to drop. A careful pointman therefore keeps a weather eye on the roof at all times and knocks the larger rocks down before they have a chance to fall on him; but in most ground it is impossible to avoid being struck with distressing frequency. Owing to the

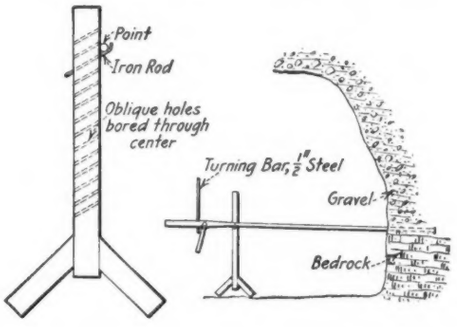


Fig. 8. Horse Sometimes Used in Point Driving, and Its Manner of Application

excessive amount of water vapor the candles flicker dimly and the pointman, fumbling around in the faint light, finds point, pipe, and hose red-hot to the touch. Gloves soon become soaked with water and offer scant protection from the heat. A tool laid to one side and forgotten for a few minutes is buried beyond hope of recovery beneath the falling waste. All in all, the pointman's lot is not particularly attractive, yet there are many who prefer that job to any other in the mine—possibly because the pay is usually a dollar more a day. Lest it be said that the preceding description is overdrawn it may be noted that it takes no account of the low roofs in some mines, where there may be no chance for hours to straighten the kinks from the back, and that the air is sometimes so thick with water vapor that a candle cannot be made to burn; in which case electric lights must be installed or a fan provided to assist ventilation. Breathing this air, however, causes no immediate distress and appears to have no injurious effects other than those due to excessive perspiration.

Use of "Sweaters" in Thawed Holes

When the point has been driven "home" it is withdrawn and used to drill another hole, and in this manner the entire face is drilled. The spacing varies from 2 to 4 ft.

at different mines, with 3 ft. as an average. When the point was first invented it was the custom to leave each in place as it was driven; but at some mines it was found that the gravel settled so tightly after thawing that the point could not be withdrawn. It was thus not only in the way of the shovelers, but was unavailable for further use until the thaw was removed. To have 50 or 60 points, each worth $10 to $20, tied up in this manner, and to require another set for putting in another thaw, involved a prohibitive expense for equipment. Thus arose the practice of withdrawing the point as soon as it was driven and replacing it with a "sweater" of ¼- or ⅜-in. pipe (Fig. 9). These sweaters, besides decreasing the investment in equipment, are less in the way of the shovelers, since they can be bent to one side without damage.

Points, while easily bent warm, are difficult to straighten cold and are usually taken to the surface if badly kinked. They may, however, be straightened underground by passing steam through until warm, laying on a plank and striking with a hammer. If this is attempted cold, the steel is very likely to break. Points also frequently become clogged in driving, and if they cannot be cleared by drawing back a foot or two and tapping with the hammer they are withdrawn and a stiff wire—telephone wire is excellent—is run up the steam passage to

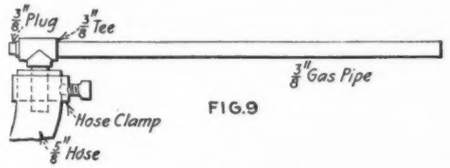


FIG. 9

A "SWEATER"

Solid plug to tap sweater in case it does not enter the point hole easily. Sometimes tee and plug are omitted

dislodge the obstruction. If this does not have the desired result, the point is sent to the surface, it being a waste of time to attempt other than the simplest repairs underground.

Many operators still leave the points in place, but the better practice is to use sweaters. These are placed in the holes drilled by the points and tested with the breath to see that they have not become clogged in entering. They are then carefully "plugged" in the following manner: Jute strips are prepared by rolling up a gunnysack tightly into a cylinder and cutting off 2-in. sections with a sharp axe. The sweater is drawn back a foot or two and one or more jute strips wrapped tightly about it some distance from the end. The sweater is then rammed "home," the jute wrapping being held in place by means of a "calking tool," which is essentially a long-handled, spoon-like affair made to fit roughly over the sweater. More strips are wrapped about the pipe and pushed in against the other if needed. The work is tested by sucking through the pipe with the mouth or by turning on steam. If it is properly done and the gravel is "tight," practically no steam will escape. It is possible in some cases, after the ground is well "warmed up," to open all valves wide to the boiler, or "back the pressure up to the boiler," as the pointmen say. This expression is not based on fact, however; the truth is that some gravel is capable of absorbing steam as fast as the pipe line will deliver it. When water is used for driving, it washes much of the clay, or sediment, out of the gravel around the point and makes it impossible to plug the sweater tightly. Points left in place are also more difficult to plug than are sweaters.

CAREFUL REGULATION OF STEAM FLOW

The pipe line having been laid, the lead hoses of the crossheads are connected and the point hoses attached to the sweaters. Steam is then turned on all the sweaters in the face at once.. Each sweater and each crosshead has a separate valve, and fine adjustment is therefore possible. The sweaters of each crosshead are regulated so that each takes the same amount of steam, and then the various crossheads are adjusted to equality. Once the valves have been properly adjusted and each sweater is taking exactly its correct share of steam they are left strictly alone, all further regulation being from the line valve or from the boiler. Adjusting the valves to equality is the most difficult part of point work for the beginner. If a valve is the least bit too wide open, that sweater will take too much steam, in which case it will very likely "blow back"; and by robbing its fellows on the same crosshead it may cause some of them to cease feeding or "go dead." The sweater may be withdrawn to observe the exact amount of steam passing through it; but a better way is to judge by putting the hose to the ear, which, however, requires considerable experience.

A series of points or sweaters may be working along perfectly when a temporary decrease in the boiler pressure or some other change in conditions will cause several of them to stop feeding, the steam passage filling with condensed steam. Consequently the points require inspection from time to time, for it is important that a "dead point" be detected at once if the thaw is to be even. In time the point will become cold clear back to the crosshead, when its condition is obvious; but it is better to make sure at an earlier stage by placing the hose to the ear. If the point is dead there will be a gurgling sound, much as is made by blowing under water with a straw; if it is feeding, the steam passes through with a clear hissing sound. Some pointmen also tell whether a point is working properly by taking the hose between the thumb and finger and feeling the "pulse"; if the steam passes through with a recurrent pulsating effect the point is feeding properly. This pulsating effect is interesting, and is probably due to the pressure at the end of the point increasing above normal and forcing the steam out into the gravel with comparative suddenness, thus decreasing the pressure for a moment.

TIME AND STEAM REQUIRED FOR THAWING

The time required for thawing depends on several factors other than the depth of thaw and the closeness of spacing the points, chief among which are the character of the gravel and the effective pressure of steam. If the gravel is loose and comparatively free from clay or sediment, a 5-ft. paystreak can sometimes be thawed in 10 hr. for a distance inward of 9 ft., with the points 3 ft. apart, and with a boiler pressure of 100 lb. As the proportion of clay increases, the time required increases, as much as 40 hr. being necessary to thaw some ground. Of course, if extra-long points are used, or if the depth of pay is unusually great, more time is required. Thus in the Prest ground on Vault Creek the pay extended so far into the roof that it was impracticable to thaw all of it; when the next thaw was put in some of the roof thawed and came down, and was removed with the new thaw.

The amount of steam necessary to run a point varies considerably; but it is usually estimated that one boiler-horsepower will run one point. Thus a 30-hp. boiler should, with good dry wood, run 30 points. C. W. Purington states ("Bull. 263," U. S. Geol. Surv., 1905, p. 92) that the boiler horsepower required to run a point varies from one to two, with an average of 1½. This, however, was before more careful attention to this detail of mining led to the development of more efficient methods, and 1 hp. to the point is probably accurate for the present time. The amount of water taken into the boiler is surprising until one becomes accustomed to it. Thus, a plant on Engineer Creek, thawing about 110 cu.yd. of gravel a day with a 40-hp. boiler, had one ¾-in. injector running continuously and another intermittently while the points were steaming.

Thawed Gravel Should Cool in Place

After the gravel has been thawed it retains its heat for a considerable length of time, and where possible a "thaw" should be left five or six days before removing. This very often is not feasible, however, owing to limitation of working faces, and much gravel is stoped while still warm. In many instances in the past the shovelers have started on a thaw immediately steam was turned off and the waste shoveled back, gravel being shoveled into the wheelbarrows while too warm to hold tightly in the hand. The practice of working in hot ground is one that cannot be too severely condemned; like the roundabout runway and the submarine wheeling plank, it is characteristic of the failure, and not of the paying mine.

Thawing, as noted in the foregoing, is estimated to account for about 20% of the total cost of mining in the Fairbanks district to date—say $6,000,000 in round numbers, on the basis that half the gold extracted was profit. In no other department of drift mining is there so much diversity of practice, and in no other—unless it be sluicing—is there so much room for improvement. Some operators take great pride in their work and have reduced thawing to a science. It is on the methods of such that the most emphasis has been laid in this paper rather than on the haphazard and less commendable method—or lack of method—of others. Labor and fuel are the principal items entering into the cost of thawing, and the introduction of a successful hammer drill for driving, as is promised within a year, will mean a great saving. Until the Government railway makes possible the use of coal for generating steam, however, the cost for fuel must inevitably become greater and greater.

Mineral Production of Great Britain

The British authorities have issued a sheet containing the production of minerals in the United Kingdom from mine workings under the Coal Mines Act and the Metalliferous Mines Act for the year 1914. The figures given do not in all cases represent the total production for the year. Some quantities of important minerals—such as iron ore, limestone, sandstone, slate, clay—are obtained from quarries and open workings under the Quarries Act, the returns from which are not yet available. The totals for coal and for the ores of copper, lead and zinc may be regarded as substantially complete.

Coal Mines

The quantity of coal mined, which was 287,411,869 tons in 1913, fell to 265,643,030 tons in 1914, a decrease of 21,768,839 tons, or 7.6%. The decrease was due chiefly to the falling off in available labor toward the close of the year.

The quantity of minerals other than coal taken out under the Coal Mines Act was, in long tons:

	1913	1914
Barium compounds	4,610	6,265
Clay and shale	457,244	399,810
Fireclay	2,585,763	2,374,068
Igneous rocks	688	634
Iron pyrites	8,964	9,359
Iron ore	7,709,624	7,241,481
Limestone	7,525	6,442
Oil shale	3,280,143	3,268,666
Sandstone, including ganister	144,923	135,718
Total tons	14,199,484	13,442,443

The quantity of ganister included with sandstone in 1914 was 121,168 tons.

Metal Mines

The production of the mines under the Metal Mines Act was as follows, in long tons:

	1913	1914
Arsenic	1,694	1,974
Arsenical pyrites	35	.....
Barium compounds	43,408	39,645
Bauxite	6,055	8,286
Chalk	.....	493
Chert, flint, etc.	5,173	3,844
Clay and shale	133,984	131,190
Copper ore and precipitate	2,705	2,519
Fluorspar	33,833	24,688
Gold ore	4	47
Gravel and sand	12,492	17,331
Gypsum	238,494	220,096
Igneous rocks	57,921	44,299
Iron ore	1,881,853	1,743,011
Iron pyrites	2,463	2,295
Lead ore	24,265	25,988
Lignite	81	300
Limestone	356,316	328,337
Manganese ore	5,393	3,437
Ocher, umber, etc.	6,199	4,463
Rock salt	214,573	189,995
Sandstone	89,718	76,198
Slate	95,271	82,307
Soapstone	40	180
Tin ore (dressed)	6,949	6,632
Uranium ore	95	344
Wolfram ore	182	205
Zinc ore	17,294	15,419
Total tons	3,236,490	2,973,523

Limestone includes 1267 tons of calcspar in 1913, and 630 tons in 1914. In addition to the tin ore reported in 1914, there were 201 tons undressed ore, not included above.

The total of iron ore reported in 1914 from the two classes of mines was 8,984,291 tons. This will be further increased by the quarries report.

Men Employed

The total number of men employed as ordinarily computed was as follows:

	Coal Mines		Metal Mines	
	1913	1914	1913	1914
Under ground	909,834	915,381	16,525	14,426
Above ground	218,056	278,365	10,887	9,283
Total	1,127,890	1,133,746	27,412	23,709

In view of the depletion of mine labor by recruiting in the latter months of the year a special return was made showing the number actually employed on the last pay day in December. The number so returned was 981,264, being 152,482 less than in July and 146,626 less than for the preceding year.

Ferrosilicon and Calcium Carbide will be made at Highlandtown, Md., by the Shawinigan Electro Products Co., a new concern organized as a subsidiary of the Pennsylvania Water & Power Co., of Baltimore.

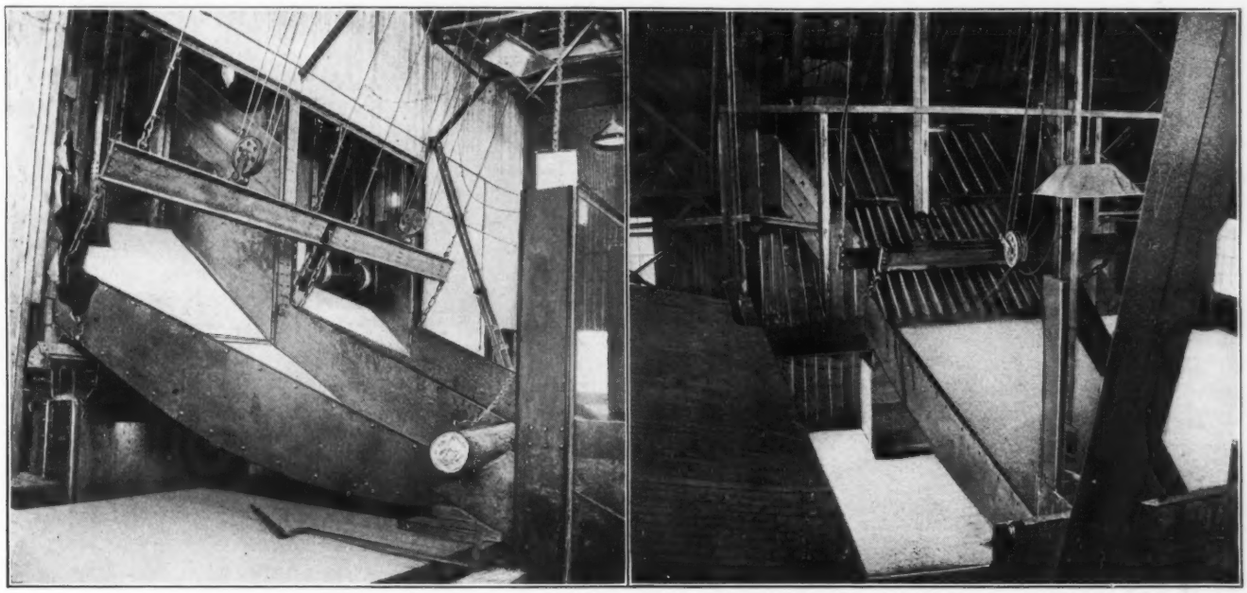
Shaft-Rockhouse Practice in the Copper Country--III

By L. Hall Goodwin*

SYNOPSIS—Rockhouse operations, distinguished from those in the shafthouse, involve handling copper rock and mass copper. Four systems in use, the Calumet & Hecla, the Copper Range, the Quincy and the Hancock. Characteristics, criticisms and advantages of the Calumet & Hecla. The tilting pan. Unusual construction of Ahmeek Nos. 3 and 4 shaft-rockhouse. Development of the Calumet & Hecla crusher. Hancock system uses a traveling link-belt grizzly.

Among the several operations carried on in the shaft-rockhouse, those which have to do with handling copper rock and mass copper are alone rockhouse processes; the shafthouse processes, such as changing conveyors, hoisting water and lowering supplies, have to do with hoisting and are presumably so classified in the cost sheet. It would also seem logical to include handling poor rock in the shafthouse operations, since if the rockhouse were in a detached building it would not handle poor rock except what little was sorted out from the copper rock. It is now intended to review the rockhouse processes of the district as a whole; there are four broad systems which will serve as a classification to which all examples may be referred. Photographs have been shown illustrating the four most recent examples; namely, Mohawk No. 6, Ahmeek Nos. 3-4, North Kearsage No. 1, and Hancock No. 2. It is only necessary to substitute in this list of recent construction the Quincy No. 2, built in 1908, in place of the North Kearsage No. 1, the latter being similar in design and operation to Ahmeek Nos. 3-4, and we have examples covering in a broad way the rockhouse practice of the entire district. Our classification will then be: The Calumet & Hecla system, of which Ahmeek Nos. 3-4 is an example; the Copper Range system, employed in the new Mohawk No. 6; the Quincy system, perfected in Quincy No. 2; and the Hancock system, of which Hancock No. 2 is the only example. The first three of these systems are used largely, almost to the exclusion of other methods; Hancock No. 2 is almost in a class by itself, as the only other instance of conveying copper rock from the hopper bin to the crusher by means of a traveling conveyor was taken up under the topic of detached rockhouses in Part I.

It will be understood that none of these mines uses a hard and fast system in all of its rockhouses. Different rockhouses of the same company, even when they were constructed at about the same time, are differently designed and operated, and often a company will employ entirely different systems; thus, the Copper Range employs the Calumet & Hecla system in two of its rockhouses, and in turn the Isle Royale group, controlled by Calumet & Hecla, uses the Copper Range system.



Ahmeek North Kearsarge

Fig. 7. Arrangements of Tilting Pans

The Calumet & Hecla System

Since the Calumet & Hecla with its subsidiary companies forms the dominating interest among Lake Superior copper mines, its rockhouse methods are used more extensively than those of any other company. The distinctive feature of its system is the tilting pan, a large scoop-shaped steel apron, hinged at its lower end, and tilted by means of friction clutches, so as to feed the rock into the crusher. A grizzly is always used, but its

*Assistant with Allen H. Rogers, 201 Devonshire St., Boston, Mass.

position relative to the tilting pan varies, as it may precede, follow or form an integral part of the pan. In the last case the grizzly bars form the bottom of the pan; this scheme was used at the time the tilting-pan system was being installed and the available space was limited; it is not used where it can be avoided. At the new North Kearsarge shaft-rockhouse the grizzlies precede the pan; at the new Ahmeek Nos. 3-4, however, the grizzlies follow. Two types are shown in Fig. 7. The grizzlies, as is the universal custom in this district, are formed of round iron bars, and in the case of the Calumet & Hecla mines these are set with 4-in. spaces to correspond to the setting of the crusher jaws.

The tilting pans are made of heavy iron, ¾ in. thick on the bottom, ½ in. thick on the sides, and both bottom and sides are protected by a ⅜-in. removable steel liner. The bottom of the pan is not flat, but is laid off on two curves, that at the top of the pan being steeper than that at its mouth; the pans are about 9 ft. wide at the top and less than 4 ft. wide at the mouth; thus they taper toward the mouth, both along the sides and in the pitch of the bottom. When the apron is full of rock and is tilted, this tapering has the effect of causing the rock near the top to push along that at the bottom, which aids in regulating the feed to the crusher.

The pan is raised by an I-beam attached to its top by chains and operated by a winch clutched to a pulley on the main line-shaft, by means of a powerful friction grip. The weight of the pan is partly counterbalanced and the ratio of the pulleys is so large that the tilting of the pan causes no noticeable strain, although the pan contains seven or eight tons of rock.

When the grizzly is placed between the tilting pan and the crusher, as is the case at Ahmeek Nos. 3-4, operations proceed as follows: When copper rock is being hoisted, the skip dumps upon a heavy iron dumping plate, from which the rock slides directly into the tilting pan, which is large enough to hold easily a skip load; the rock is prevented from passing through the pan and into the crusher by means of a rough log of wood suspended by chains across the pan mouth. The rockhouse men now pick out the waste and the mass copper, and when this operation is completed, the log is raised by a friction-clutch arrangement exactly like the one which tilts the pan, and the pan is tilted until the rock begins to slide out of the pan and into the crusher. These operations require the services of two men, one to operate the friction winches, the other to pick out the mass and waste, clean down the grizzly, etc. The large crusher permits the rock to be fed rapidly, and the whole operation of feeding a 7-ton skip load should not consume more than 2½ min.

With the grizzly in other positions, the operation is the same, except that the rock first passes over the grizzly and then the tilting pan feeds directly to the crusher. The plan of having the grizzly follow the pan was adopted at the Ahmeek Nos. 3-4 because the unusual design of that building, to be discussed later, did not permit the grizzlies to be placed before the pan. This arrangement would appear to be particularly advantageous, because the rock is fed to the grizzly slowly, and a much larger proportion of the undersize goes through than is the case where the dumping skip hurls its whole load on the grizzly bars at once. The wear on the bars is also less, since they may be set at a steeper angle; finally a more uniform mixture of stamp rock is secured in the bin because the grizzly is near the crusher. The method is not proving so satisfactory as expected, however, for the reason that the rock as it leaves the pan does not have enough initial velocity to take it over the grizzly, and some of it remains there, causing trouble. Hence the management in later installations will stick to the old custom of having the grizzly precede the pan.

Criticisms of the System

The system is freely criticized, but the criticism usually comes from those who are acquainted only with the earlier developments. Originally the pans were made of comparatively light iron, which required to be frequently renewed; there were two pans and two crushers for each double-compartment shaft—that is, one pan and crusher for each skip; the pans were tilted by air cylinders, which were wasteful of power; and the small crushers used at that time did not permit of rapid feeding. As made at present the pans can resist heavy wear and tear; the friction-clutch mechanism consumes less power and causes less trouble than did the old air lifts; only one pan and one crusher are used for two skips, which reduces the equipment and the large crusher permits rapid feeding.

The most valid criticism would appear to be that no storage capacity is provided before the crusher, so that if anything goes wrong with the single crusher or pan, hoisting must be immediately suspended. The reply to this is that with the massive type of crusher used, and with proper maintenance of other equipment, accidents which would delay hoisting are not supposed to occur. This statement, although it sounds rash, would perhaps appear to be more reasonable after an inspection of the equipment of one of these rockhouses; and as a matter of fact little trouble is caused in this way. It must be remembered that where a hopper bin is used it is never of sufficient size to hold the product of more than an hour or two of hoisting operations, so that it provides storage capacity to carry the rockhouse over minor accidents only. The power consumed in tilting the pan must be considerable, but with the friction clutch the power required is probably not much if any greater than that required for the several inefficient air lifts used where a hopper bin is employed.

Advantages of the System

The great advantages of the system are the small amount of hard work required of the rockhouse men and the speed with which the rock may be fed to the crusher, thus permitting two men to take care of a large tonnage. At the Allouez No. 2 rockhouse, two men easily handle about 500 tons of rock per eight-hour shift, and one of them performs the function of the lander, so that under ordinary conditions there are only two men in the shaft-rockhouse. The new Ahmeek Nos. 3-4 employ five men—that is, two rockhouse men for each shaft and one lander to attend to both shafts, or two and one-half men per shaft. The reason for the small amount of labor required is that the rock feeds to the crusher automatically, and there is no form of chute opening in which the rock can get wedged. All other methods require a bin opening, and it is true that more or less trouble is always encountered in getting the rock through that opening. The principal wearing parts are confined to

the dumping plate, grizzly bars, and the tilting pan; and the heavy construction of these requires only a small amount of repair work to keep the equipment in first-class condition. Friction winches of the present form have in some cases been in place four years, and in no instance has the smaller of the two pulleys had to be renewed or repaired, while in only a few cases have the larger ones needed attention.

Ahmeek Nos. 3-4 Shaft-Rockhouse

The accompanying elevation, Fig. 9, of the new Ahmeek Nos. 3-4 shaft-rockhouse, furnished by H. C. Felver of the local office of the Worden-Allen Co., the builders, will show the general dimensions and the structural features of that building. The plant is a novelty in that it serves two incline shafts, each having two hoisting compartments and serving a mine of large ultimate output. As there are two shafts there are also two tilting pans and two crushers; the stamp-rock bin is of about 2500 tons' live capacity, and is served by two railroad tracks. The whole building is, of course, much larger than the usual incline-shaft headworks, and is comparable to those over the vertical shafts having several hoisting compartments. There were used in its construction 615 tons of structural steel, which compares with about 700 tons in the Tamarack No. 5 vertical. Fig. 8 shows the plant under construction.

The peculiar relations existing between the boundary lines between the Mohawk and Ahmeek companies and the strike of the Kearsarge amygdaloid lode made necessary the adoption of several interesting features in the design of this building. In this vicinity the Ahmeek property is bounded by section lines running north and west from the southeast corner of section 28, and in this southeast corner the property does not carry the outcrop of the Kearsarge lode, but is underlain by it at a depth of roughly 1000 ft. The property line running north from that corner makes an angle of about 52° with a line parallel to the strike of the lode, and the property line running west makes an angle of about 38°. To meet these conditions the company decided to locate two shafts in the extreme southeast corner of the property and to start these shafts from the same point, the northerly one was pointed so as to run along the eastern boundary of the property but diverging from it, the southerly one so as to tap most advantageously the rest of the property. The shafts thus form a V with each other, at an angle of 41° 50′; their dip at the surface is 80°, and they continue on this dip until a depth of 980 ft. is reached, where they assume a curve with a

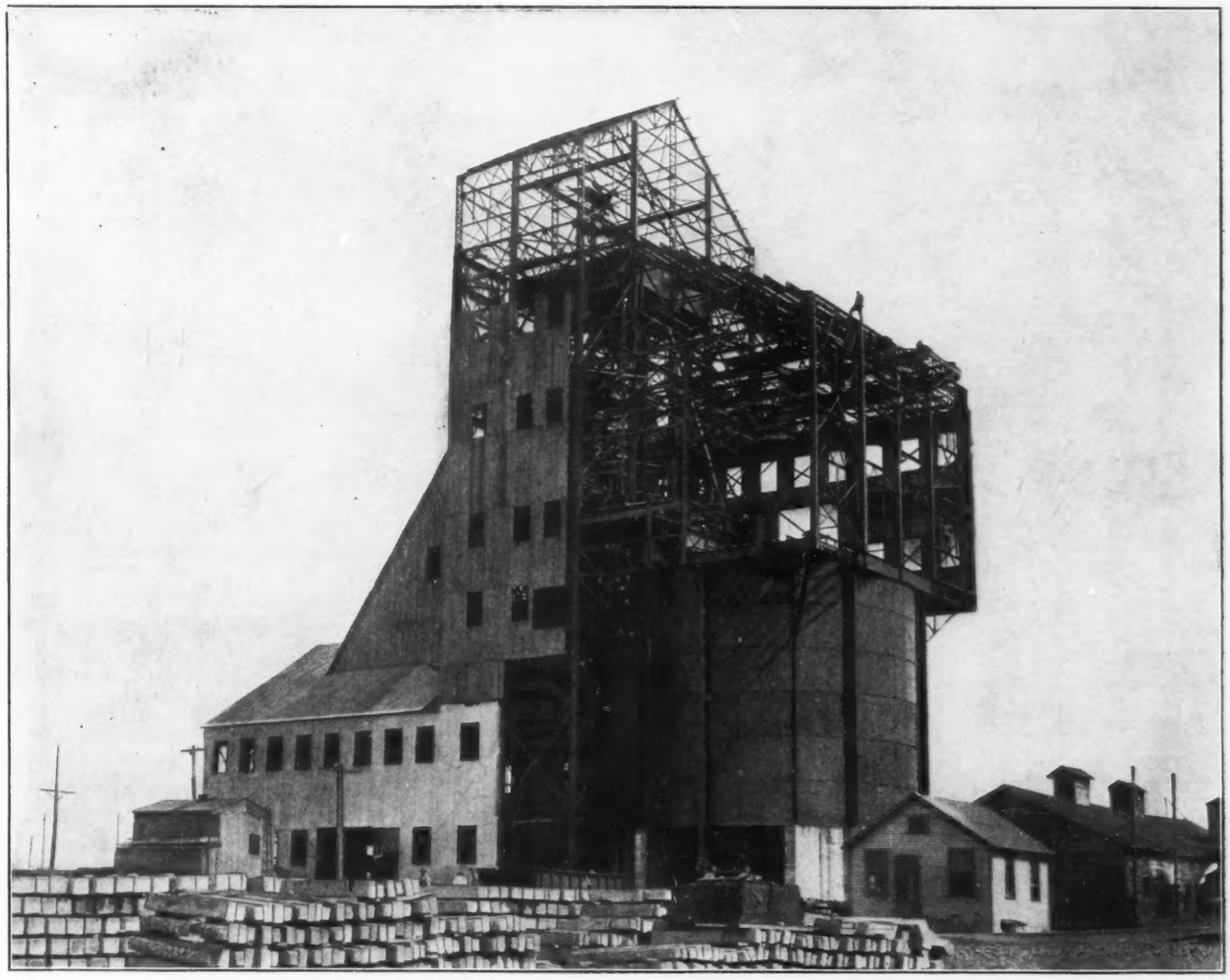


Fig. 8. Ahmeek Nos. 3 and 4. Shaft-Rockhouse during Construction

radius of about 400 ft., which takes them into the lode at a depth of about 1275 ft., after which point they follow the dip of the lode, which is variable, about 34°.

The hoisting plant in this case is on the hanging side of the shaft-rockhouse, because the company does not own the land on the opposite side. This requires a different headframe bracing than the ordinary shaft-rockhouse, the head sheaves being supported by a four-post frame such as is often used over vertical shafts, while the back brace constitutes the sloping roof of the building. The plane passing through the centers of the drums and the hoisting rope in the shaft are not perpendicular to the earth's surface on account of the peculiar arrangement of shafts and hoist; for this reason the head sheaves have to be tilted into a plane which departs 3½° from the perpendicular. This was not allowed for in the structural steel work, but is taken care of by the boxes carrying the sheave axle, one of which is set higher than the other.

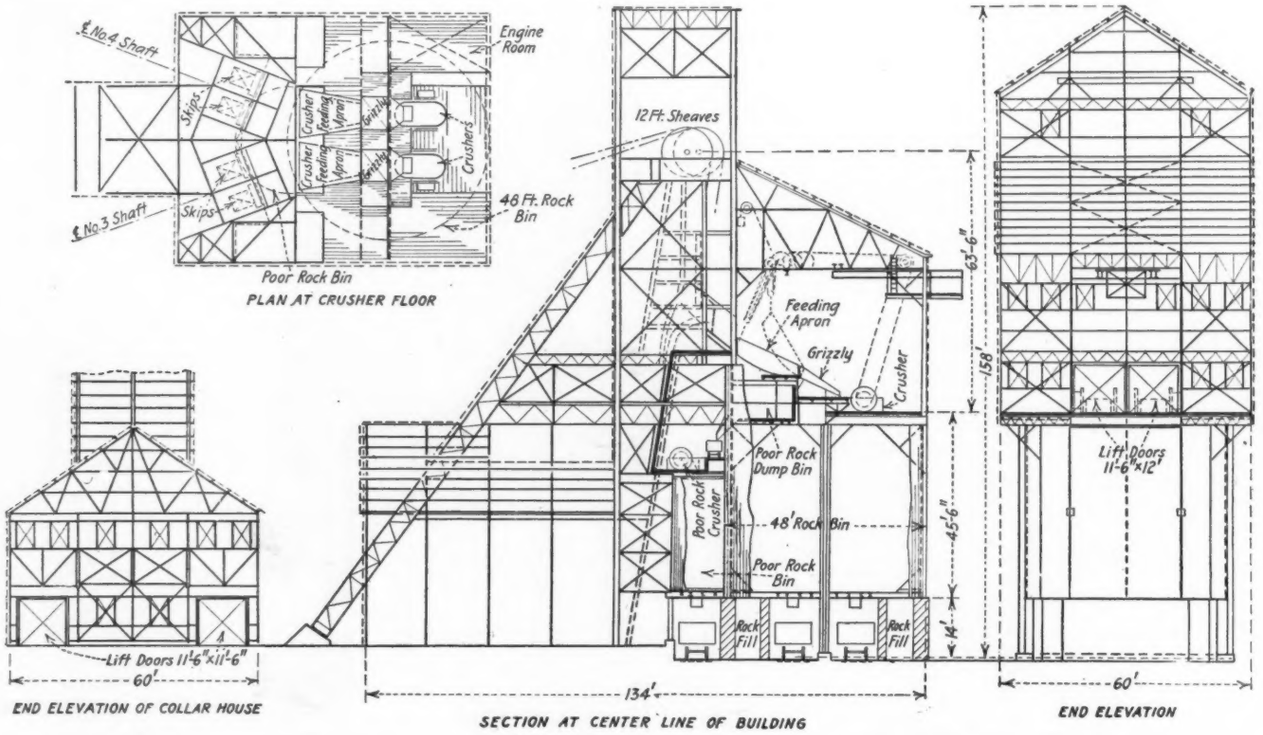


FIG. 9. PLAN AND ELEVATIONS OF AHMEEK NOS. 3 AND 4 SHAFT-ROCKHOUSE SERVING TWO SHAFTS

The design of the building is further complicated by the fact that the skip tracks in the two shafts do not lie in a single plane. Their relative position may be visualized by assuming that the tracks in the two shafts form the elements of adjacent faces of a truncated triangular prism, the angle between these adjacent faces of the prism being 138°. Taken all in all the building must have furnished some interesting problems in structural design.

CALUMET & HECLA CRUSHER

I have already spoken of the new design of Blake crusher made by the Calumet & Hecla. The principal improvement over the usual type of Farrell crusher consists of a one-piece ribbed frame, which is strengthened by three 5-in. bolts running along either side, by three 4-in. bolts across the front end, and by two 4-in. bolts across the rear end. These bolts, as well as the 8-in. hexagonal nuts which tighten them, are put in place hot, and this causes a considerable initial compression in the frame, which renders it extremely resistant to rupture. By this means the weight of the crusher is kept down to 40 tons, which is the same as that of the usual 24x36-in. Farrell crusher, while its size is increased to 24x48 in., and its capacity is also increased.

Minor improvements in design consist of a new toggle and toggle bearing, by which a rolling action in the bearing reduces the wear caused by the usual sliding action; the weight of the pitman is taken from its bearings by springs suspended from a yoke attached to the crusher frame, which causes less wear on the bearings, reduces the power, requires less oil, and eliminates the necessity of cooling the pitman by dripping water, as is often done; the angle between the jaws is increased, which allows a smaller depth of frame for the same jaw opening, and is particularly beneficial in preventing the clogging of the crusher by pieces of mass and in aiding in the extraction of mass that does become wedged between the jaws; this contingency is also guarded against by the simple expedient of marking an arrow on the end of the shaft to show the exact position of the eccentric, so that if the crusher does get clogged, the men may easily tell which way to move the flywheels to open the jaws. The jaws are not corrugated, which also aids in the extraction of mass, as it permits it to be worked sideways.

The ability of this 40-ton crusher to take boulders ranging up to 24x48 in. in size and to stand up for long periods under the strain of reducing them to 4-in. size is enough to commend it highly. It is probable that this crusher has been a large factor in enabling the Calumet & Hecla to perfect its tilting-pan system, by

avoiding the necessity of providing storage capacity before the crusher. The points mentioned as aiding in the extraction of mass copper which has clogged the jaws have been beneficial in reducing the number and length of the temporary shutdowns due to that cause. I was told of one case in which, during the absence of the rockhouse foreman, several men were kept busy for 20 hr. in a vain endeavor to remove a mass by force from the jaws of a crusher, and in so doing nearly removed the crusher from its foundations; the mass was finally removed by turning the flywheels through a quarter revolution and thus loosening the jaws, an operation

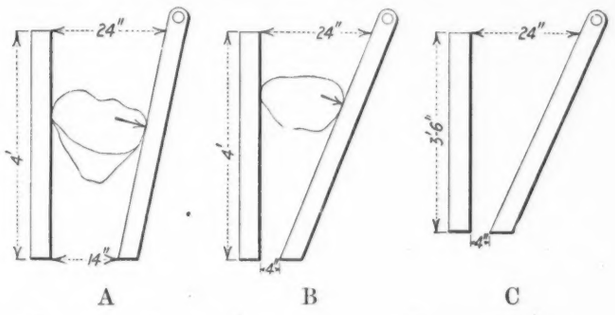


FIG. 10. DEVELOPMENT OF THE COPPER-COUNTRY CRUSHER

probably requiring about 15 min. With the slight eccentricity used, it is impossible to tell by inspection which way the flywheels should be turned to loosen the jaws, unless some special provision is made.

The mechanical advantages of this design as compared with earlier ones may best be shown by a comparison of the friction loads, that is, the horsepower required to run the crusher at normal speed when no rock is being crushed. In the case of the new crusher the friction load is about 16 hp., while that of a smaller crusher of the design previously used is 29 hp. This considerable saving is due chiefly to the improved toggle, the suspended pitman, and the lighter weight. The capacity of the crusher is indicated by a test run at one of the amygdaloid rockhouses, during which an average of 105 tons per hr. was crushed for four consecutive hours.

EVOLUTION OF THE CRUSHER

The statement made in Part I that the original designs of the Blake crusher were not strong enough to reduce large sizes of rock to 4-in. size in one operation should perhaps be modified to read that people thought they were not strong enough to do this. A few years ago it was thought that no crusher could be made strong enough to resist the strains imposed by this operation, but that this opinion had no basis in fact and that no great amount of thought had been put on the subject will be made evident by a consideration of Fig. 10, which is plotted to scale and which shows diagrammatically the increase in the angle between the two jaws of the crusher in the later designs. *A* represents the original conditions existing at the Calumet & Hecla where it was the practice to break first in a 24x36-in. crusher, set to crush to 14-in. maximum size, and to finish the operation in a 17x24-in. crusher breaking to 4 in. A rock house foreman who took the pains to study the matter decided that the 24x36-in. crushers could be made to reduce large boulders to the 4-in. size in one operation. Perhaps he drew a sketch corresponding to *A* and *B* which showed that a greater strain is produced on the crusher when the jaws are set to break to 14 in. than when they are set to break to 4 in., since in the former case the advance of the swinging jaw is opposed by a force acting nearly perpendicular to its face, while in the latter case this opposing force acts at a smaller angle. The disadvantage of course comes in the smaller capacity of the crusher, but on investigation it was found that during a 10-hr. shift the crushers were actually working about three hours only, so that the smaller capacity was not a disadvantage in this case. When these facts had been established, all of the old 24x36-in. crushers at the Calumet & Hecla mines were remodeled with longer toggles and made to crush to 4 in. in one operation; these crushers are still giving good service.

HANCOCK NO. 2 SHAFT-ROCKHOUSE

The Hancock method of handling copper rock cannot be taken as a typical system, because it is at present almost unique among Lake Superior methods, and it was adopted because of special conditions which perhaps will not lead to its being copied extensively. The building and method are worthy of consideration, however, as being thoroughly modern examples of how adverse conditions, such as confronted the Tamarack mine in the early days, have been overcome. The Tamarack property, it will be remembered, carried the underlay of the Calumet & Hecla conglomerate lode at a depth which required some of the deepest shafts in the world to reach. The problem confronting the Hancock was somewhat different, but at this time it will suffice to say that it was necessary to sink a vertical shaft 3600 ft. before it tapped the famous Pewabic lode, from which the neighboring Quincy mine has paid over $20,000,000 in dividends.

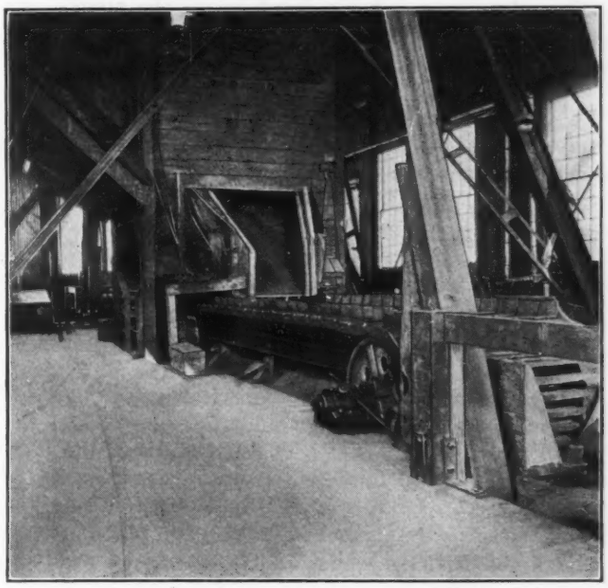


FIG. 11. LINK-BELT GRIZZLY AT HANCOCK NO. 2

The Hancock No. 2 shaft has six compartments, in four of which hoisting is done in 8-ton Kimberley skips working in balance. The shaft is not yet working at anything like its ultimate capacity, but hoisting is being regularly conducted. It was this large hoisting capa-

city, together with the fact that the mine is dependent upon an outside railroad for its transportation facilities, which determined the management to provide extra large storage capacity in two steel bins of the usual type, each holding 800 tons of rock. In turn it was this factor of two large bins which determined the method of handling copper rock used.

The four skipways are in a row, and the skips all dump in one direction, the rock going into a small hopper bin with a V-shaped bottom which divides the rock from the dumping skip in two portions, to feed two crushers set on opposite sides of the hopper bin. From the bin, openings 2 ft. high and 4 ft. long having chutes without gate deliver the rock to a link-belt conveyor, Fig. 10, traveling at the rate of 18 ft. per minute, the links of which form grizzlies having 2¾-in. spaces. Each conveyor feeds automatically to a 24x36-in. crusher. Power is furnished by a motor-generator set; each crusher is run by a 50-hp. induction motor, each conveyor by a similar motor of 10 hp. The conveyor motors may be started and stopped easily, so that there is no danger of feeding the crusher too rapidly, and power is not consumed by operating the conveyor when not necessary.

The operation of the system is simple. The rock from the bin spreads itself evenly on the conveyor in a bed about 10 in. thick. A large proportion of the undersize goes through the grizzlies just under the chute from the hopper bin, the remainder of it is easily worked through by the crusher men, who, by using hooks a little, stir the rock sufficiently to cause the undersize to go through.

The advantages and disadvantages of the method are similar to those of the Calumet & Hecla. Although a hopper bin is used, it is too small to furnish storage capacity over any length of time; and the link-belt conveyors consume considerable power. The great advantage comes in the automatic feeding of the rock to the crusher and the small amount of other work required, which enables two men to handle easily a large quantity of rock.

(To be concluded)

Pan-Americanism

By Glen Levin Swiggett*

During 1915 two great Pan-American gatherings will have convened in Washington under the auspices of the United States Government. The first of these, the Pan-American Financial Conference, took place the week of May 24, 1915. In this conference delegates from the Latin-American countries conferred with representative bankers and business men from our nation at the Pan-American Union, on invitation of the Secretary of the Treasury, on financial questions of pertinent interest that must have far-reaching beneficial results to Pan-American banking and commerce.

Of greater interest to the engineering world, however, is the scientific congress that will convene beginning Dec. 27, 1915, and concluding its sessions on Jan. 8, 1916. Through the splendid coöperation of the Latin-American countries the second Pan-American Scientific Congress, held under the auspices of the United States Government through the Department of State, bids fair to be not only thus far the greatest Pan-American Congress, but the most important international scientific congress ever held in the United States. The first congress of this name was held in Santiago, Chile, in 1908. It had its origin in earlier Latin-American scientific congresses; and at the time of the Santiago congress was enlarged through the generous initiative of the Latin-American countries to include the United States. This congress was well attended by visiting delegates from the United States. On its adjournment, entirely unsolicited on the part of the latter, Washington was designated as the place of meeting of the second congress.

This honor has a singular appeal to our nation at this time. The present European war has brought the Western Hemisphere suddenly face to face with grave economic problems that invite the serious attention of scientists and experts in the various fields of applied science. The scientific congress will concern itself with the constructive discussion of these, as well as with the contributions in the domain of pure science, wherein great advance has been made since the last congress held in Santiago, Chile.

The significance of the congress is greatly enhanced through the international reputation of the persons chosen to arrange for the programs of the different sections of the congress, most of whom have an intimate, first-hand acquaintance with the local resources, development and scientific interest in the various Latin-American countries.

Washington offers unusual advantages for a congress of this nature. It enjoys an enviable distinction among the world capitals for the keen scientific interest and investigation in its various Federal bureaus, the varied and extensive nature of its libraries and museums, the beauty of its buildings and the growing importance of detached but semi-official institutions and bureaus engaged in work of international scope. Among these none occupies a position of greater importance than the Pan-American Union, the governing board of which, composed of the diplomatic representatives of the participating Latin-American countries, with the Secretary of State of the United States as ex-officio chairman, has signally honored the Second Pan-American Scientific Congress by authorizing the use of its beautiful building for the office and sessions of the congress. The board also, in response to the request of the President and the Secretary of State of the United States, has authorized John Barrett, the director-general of the Pan-American Union, to act as secretary-general of the scientific congress. He has doubtless done more than any other American in the establishment of commerce and comity among the republics of the Western world.

*Assistant secretary of the Congress.

Record Rate of Loading Iron Ore

Special Correspondence

In May a new loading record was made at the Duluth, Missabe & Northern docks. Ten boats were loaded in one 10-hr. shift, taking away from the pocket 86,000 tons of ore. During the same period 1213 cars were unloaded into the ore pockets.

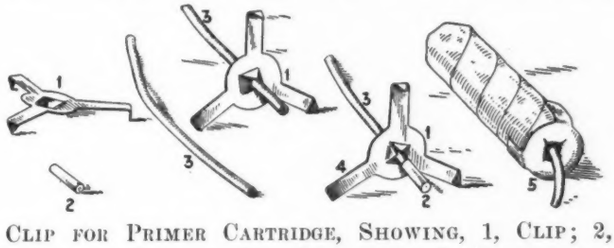
A new record has been made this month at the same docks, when a total of 109,800 tons was loaded in 9 hr. and 45 min., 15 boats being loaded and sent away. The average rate of loading was 11,262 tons per hour and the average loading time per boat was 39 min.

Details of Practical Mining

Clip for Detonator

The method of inserting the detonating cap in a stick of dynamite so that it will have no tendency to pull out is often a subject of both trouble and discussion. The best method advocated by the manufacturers of explosives is to insert the primer in a hole made in the powder by a pointed stick, after having unfolded the end of the paraffin paper wrapper, and then gathering the covering around the fuse and tying with a string. There is no objection to this method except the time required to do it. It is a fussy job to do this. The miner is liable to find that his fingers are all thumbs when it comes to tying a knot in a fine piece of string, and although he and the foreman may both start out with more or less zeal, patience is soon exhausted, enthusiasm wanes and back they go to the old method of lacing the fuse through the stick of dynamite, with all the attendant risks of burning out holes and the usual disadvantageous results.

In the *Journal* of the Chemical, Metallurgical and Mining Society of South Africa, Vol. 14, page 366, W. Cullen suggests a clip he has devised that is extremely simple and accomplishes all of the much-to-be-desired results with a minimum of trouble and effort. This clip consists of a



CLIP FOR PRIMER CARTRIDGE, SHOWING, 1, CLIP; 2, CAP; 3, FUSE; 4, ALL ASSEMBLED; 5, ASSEMBLED WITH CARTRIDGE

circular sheet of thin malleable metal, like copper, with three equidistant arms projecting from the circumference and a star-shaped, pronged hole punched in the center. Each of the equidistant arms has its end sharply pointed and the point turned up. In use, the fuse with the detonating cap attached is pushed through the hole, the detonator is crimped on the fuse by pliers in the usual way, and the cap is then inserted in the hole punched through the end of the stick of powder, wrapping paper and all. Then the arms are folded down about the cartridge and the pronged points piercing the wrapping paper clinch the clip so that it cannot be pulled off the stick of powder. This prevents the detonating cap and fuse from being pulled out of the star-shaped hole.

This method is much quicker than lacing the fuse through the stick of dynamite and is much better in every way. These clips can be stamped out of thin sheet copper at the mine or in any local machine shop, and it is expected that they will soon be put on the market by an Eastern manufacturing concern. Their use is advocated, and the method of using is fully shown in the accompanying illustration.

Cold-Air Intake Duct for Air Compressors

It has often been observed that the output of an air compressor is greater in winter than in summer; that is, it seems that a machine which has had to "hustle" to furnish air in summer, may be able to maintain the required pressure at a reduced speed during the winter. The reason for this is often asked, and R. S. Bayard, in *Power*, May 25, 1915, discusses the matter in detail.

This difference can be observed only when the compressor takes its air through a duct leading from the outside air, because it is due to the effect of the difference of air temperature between the compressor intake and that air about the compressor.

Imagine a cylinder having a perfectly tight piston held, we will say, at midstroke, and the half-cylinder full of air at atmospheric pressure and at a temperature of 60° F. The atmospheric pressure is, with 30-in. barometer, 14.7 lb. per sq.in. With the piston held rigidly and leak-tight, assume that we can heat the cylinder so that the air inside will become 100° F. This will cause the air to expand and try to occupy more space, but if the piston will not move, the air cannot expand, so it will increase in pressure. Mathematically, the pressure produced in this way will be

$$14.7 \times \frac{100 + 460}{60 + 460} = 14.7 \times \frac{560}{520} = 15.84 \textit{ lb. per sq.in.}$$

That is, the new pressure, absolute, will be equal to the first pressure, absolute, multiplied by the ratio of the absolute temperatures.

If, in the cylinder we are considering, the piston is allowed to move as the air expands and if it has no friction, so that the air pressure does not increase, the final volume will be larger than the original volume in the ratio of the absolute temperatures. If the original volume was, say, 10 cu.ft., the final volume after the piston has moved, due to increase of air temperature, is

$$10 \times \frac{100 + 460}{60 + 460} = 10 \times \frac{560}{520} = 10.77 \textit{ cu.ft.}$$

At the usual room temperatures (about 520° F. absolute) the increase of volume is, roughly, 1% for every 5° F. increase of temperature.

Let us see how the foregoing applies to a compressor plant. Irrespective of the outside temperature, the air in the shop pipe lines will be nearly at the temperature of the room by the time it reaches the tool. Suppose in winter this temperature averages 68° F. and that the air finally reaches the tool at this temperature. If the compressor takes in 1000 cu.ft. of free air (air at atmospheric temperature and pressure) directly from the room, it will also deliver 1000 cu.ft. of free air at the tool, because the final temperature is the same as that at which it entered the compressor.

In summer the same conditions apply as long as the compressor takes its air from the same room in which the compressed air is used; but if the compressor is provided

with an intake duct leading from the outside air, the result will be quite different. First, consider the winter condition. Suppose the shop temperature averages 68° F. and the outside air 30° F. If the air is used at 68°, its volume will be considerably greater than the volume taken into the compressor from the outside air at 30°. If it requires 1000 cu.ft. of free air per minute at shop temperature to run the tools, the compressor will have to take in only

$$1000 \times \frac{30 + 460}{68 + 460} = 1000 + \frac{490}{528} = 929 \; cu.ft.$$

which is a saving of over 7% in air capacity, speed and horsepower. In summer, when the outside temperature is practically the same as the temperature indoors, there would be no saving by using the intake duct except, as is often the case, when the compressor takes its air supply directly from the hot engine room. Thus it is seen that the compressor would run at a speed about 7% lower in winter than in summer. The colder the climate, the more pronounced this effect would become.

An actual case where the application of an intake duct to a compressor represented an appreciable saving recently came to my attention. An air compressor furnishing an average of 2500 cu.ft. of free air per minute to a machine shop took its supply from the basement of the engine room, where all the year round the air, heated by a network of steam pipes, averaged 95° F., while the shop averaged 70° F. During the winter months the outside air averaged 32° F., and in summer 70°. Based upon the average consumption of 2500 cu.ft. per min. for 10 hr. a day, the air used amounted to an average of

$$2500 \times 60 \times 10 = 1{,}500{,}000 \; cu.ft.$$

per day at the shop end.

As the compressor-intake temperature averaged 95° F., the compressor was obliged to run fast enough to take in

$$1{,}500{,}000 \times \frac{95 + 460}{70 + 460} = 1{,}500{,}000 \times \frac{555}{530}$$
$$= 1{,}570{,}500 \; cu.ft.$$

of engine-room air per day.

The cost of compressed air in this plant was found to be 2.8c. per 1000 cu.ft. at the compressor. Thus the cost of furnishing air to the shop was

$$\frac{1{,}570{,}500}{1000} \times 0.028 = \$43.97 \; per \; day$$

By putting in an intake duct and furnishing air to the compressor at 30° F. in winter, the compressor could have been run slower and would have had to take in only

$$1{,}500{,}000 \times \frac{30 + 460}{70 + 460} = 1{,}500{,}000 \times \frac{490}{530}$$
$$= 1{,}387{,}000 \; cu.ft. \; per \; day$$

At a cost of 2.8c. per 1000 cu.ft. at the compressor intake, the average cost of air for the plant during winter would then be

$$\frac{1{,}387{,}000}{1000} \times 0.028 = \$38.84 \; per \; day$$

During the summer, when the outside and inside temperatures both averaged 70° F., the compressor would take in only the amount used in the shop, or 1,500,000 cu.ft., which at the cost of 2.8c. per 1000 cu.ft. at compressor intake would be

$$\frac{1{,}500{,}000}{1000} \times 0.028 = \$42 \; per \; day$$

With the intake duct in use we then have a daily cost for air of $38.84 for winter and $42 for summer. The average for the year may then be taken at $40.42 per day, as against $43.96 with the compressor taking air from the engine-room basement.

During a working year of 300 days, the annual cost for air would then compare:

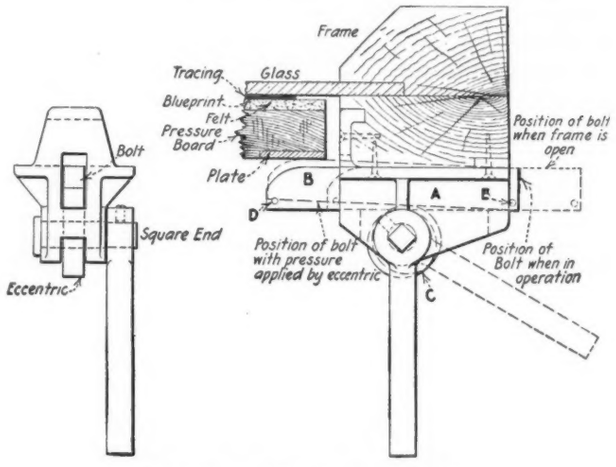
Without intake duct	$43.96 × 300 =	$13,188
With intake duct	40.42 × 300 =	12,126
Giving a net saving with the duct of		$1,062

Capitalized at 10%, this would justify installing an intake duct costing $10,620. As this figure approaches more nearly the cost of the compressor than it does the cost of the duct, the conclusion is obvious.

Incidentally, the saving of $1062 per year amounts to more than 8% of the yearly cost for air. It certainly appears to be worth while to install an air-intake duct under such conditions.

Clamp for Blueprint Frame

F. J. Hibberd in the *American Machinist* describes a clamp for blueprint frames for use in those drafting-rooms where the electric blueprinting machine has not been introduced, but where the old-style sun frame still exists. There are many devices used for clamping the pressure board down on the back of the frame so as to give the necessary close contact between the tracing and



DETAILS OF BLUEPRINT CLAMP

the glass. The common door-bolt, which is the device generally used, is a most unsatisfactory means of securing this contact.

The illustration shows an improved method. It is composed of a brass bracket *A*, which is fastened by screws to the side of the frame. It has a sliding piece *B*, which can be moved in and out by hand like a "bolt" and is so designated in the illustration.

Underneath this bolt is an eccentric disk *C*, which is fastened to a pin and has a hand lever fitted in its square end. When the bolt is shot into place, the lever is pulled over to the right, as shown by the dotted lines, and the eccentric disk forces the bolt up in the direction of the pressure board, thereby pressing the tracing against the glass of the frame. There are pegs, *D* and *E*, to limit the movement of the bolt. Of course in actual use the whole appliance is reversed and remains so till the clamping is complete.

Engineering Notes and Methods at Miami

By H. P. Bowen*

SYNOPSIS—Kinks about underground surveying, best instruments, tapes, reels, etc., to use; methods of taking and keeping notes, filing them for office use and recording them on maps and assay plans; use of tracing cloth, blue-print and black-print papers.

The graduate of any one of our technical schools leaves college with a more or less clear idea of how to perform certain field and office engineering work with extreme accuracy. All the training he has received tends to that one end. He is theoretical rather than practical in his work, and it is generally some time before he begins to realize how large a structure of practice must be erected upon his small foundation of theory.

Practical engineering is a science of approximations. Absolute accuracy is as impossible here as elsewhere, and near-accuracy is often economically wrong. The first point to be decided in the laying out of any work is to what degree of accuracy the work in question should be done; the second, how to do it as quickly as possible with the least work and the least chance of error. For example, the elevation of a certain point is required. This may be obtained in the three following ways: The elevation within from 5 to 10 ft. can often be scaled off a contour map; an accuracy within 1 or 2 ft. may be obtained by a stadia shot or two from a known bench mark; or the elevation may be accurately determined by running a line of levels to the point in question. While more accurate, either of the latter methods would mean time and work wasted were only an approximate elevation desired.

Everyone makes some errors in his work. They must be found before the work has gone far enough to cause trouble. An engineer cannot afford to let pass any opportunity of checking his work. No matter how monotonous the work, one must not fall into the mistake of doing it mechanically, or some error will creep in and pass by unnoticed.

If in plotting or checking a piece of work it does not *seem right,* it should be checked and rechecked, preferably by someone else, for the chances are in favor of there being a mistake in it.

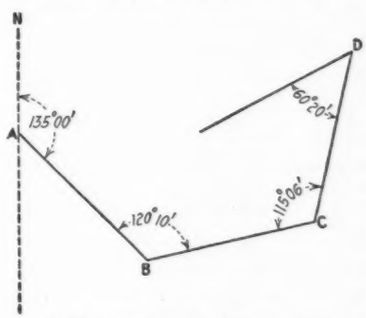
Every engineer has a favorite among the various makes of surveying instruments, but it must be borne in mind that a good engineer can do good work with a poor instrument, while a poor one cannot do good work with the best instrument made. The class of the instrument and the shape it is in will affect only the time and care necessary to do the work right.

Ordinary underground work consists mostly of putting in line-plugs for drifts and crosscuts, lining up timbering and a certain amount of leveling. The class of transit I have found most convenient for this work is a small instrument with U-shaped standards and no compass box. The chance of error in reading the horizontal circle has been lessened by having it graduated only one way from right to left and from 0 to 360 deg. It has a horizontal, vertical and two diagonal cross-wires and two stadia wires. Cross-hairs and graduations are made coarser than usual to make them easily read in the poor light underground. For shaft plumbing and long connections a larger and more finely graduated instrument is used.

*Care of Miami Copper Co., Miami, Ariz.

Tapes and Reels

The question of tapes and reels is one that is hard to decide. I have yet to see a reel that is perfectly satisfactory and will stand up under the hard usage it receives underground. Reels for 500-ft. tapes are too heavy and clumsy to carry around. All reels fall down when used underground on account of the grit cutting out the bearing surfaces. For the latter work a reel should be of the size necessary to take a tape 50 ft. longer than the one used. This will keep it from binding with the dirt and grit it picks up. For surface work a 500-ft. wire tape 1/8 in. wide graduated on brass sleeves for every foot of its length is used. This is better than a shorter tape, especially in a rough country. For underground surveying a heavy 5/8-in. tape heavily etched to feet, tenths, and hundredths is giving the best satisfaction. A thin tape will not stand the rough usage and a 1/8-in. tape, besides being difficult to read, crystallizes after some use and becomes brittle. For the samplers, heavy 5/8-in. tapes etched to feet are preferable. Graduations on babbitt, copper or brass soon wear off and cannot be read.



A Traverse by Azimuths

The bearing is carried underground by jiggling in line with two wires suspended in the shaft. A quick method of "jiggling in" is as follows: Set the instrument tripod as near as possible in line with the two wires, having two of its legs parallel with and one at right angles to the line of the wires. Put on the transit head and level up the instrument. Now if the transit is nearly in line as it should be, it is possible to jiggle in by raising or lowering the tripod leg which is at right angles to the line of the wires, and then leveling up the instrument. By moving the tripod leg instead of the transit head it is possible to move the transit a minute distance, and the subsequent leveling lessens this. Size No. 6 piano wire is used for plumbing raises and shafts up to 200 ft. and size 8 for greater distances. Weights for plumbing can be made from short lengths of iron pipe filled with lead. Slots cut in the pipe will permit the insertion of tin vanes, which should project about an inch beyond the pipe, causing the weight to come quickly to rest when in use.

Our underground stations in the Miami company's mines consist of spads either driven in caps or in plugs set in holes drilled in the rock. In the former case such a station is never used for work of importance without checking back on stations set in the rock. A cap will sooner or later move more or less, no matter how solid the timbering may appear. In an entirely timbered working, an intermediate point put in line with any two stations will prove by lining up at any time whether any one of the three points has moved. In such workings permanent stations can often be made by punching a point in a moil driven into the floor. Spads are made from No. 4½ horseshoe nails. Larger sizes split the plugs. The heads are hammered flat and slots for the plumb-bob cord cut with a hacksaw.

Every angle in an underground traverse is doubled and both the original and doubled reading are recorded on cards carried for that purpose. These cards are carried in a tin holder and are filed away in the office daily.

Bearings by Azimuths

In the hurry of underground work, mistakes in calculations, especially those that must be made on the ground, are easily made. A method that will make the calculations almost entirely mechanical will result in the fewest errors. For this reason we figure our bearings by azimuths. By the azimuth of any course I mean the horizontal angle turned to the right between the first station, on a course due north, and any other station on the course. To get the azimuth of any course in a traverse, take the azimuth of the preceding course from back sight to station set on, add 180° and the horizontal angle read to the right between the station set on, back sight and fore sight, and the result will be the azimuth required, unless it is greater than 360°. In this case subtract 360° if the result is not greater than 720°, and 720° if it is, and the difference will be the azimuth.

To illustrate, take the courses in the figure, *A, B, C, D, E,* then:

		Deg.	Min.
Azimuth AB	=	135	00
		180	00
Angle ABC	=	120	10
		435	10
		360	00
Azimuth BC	=	75	10
		180	00
Angle BCD	=	115	06
		370	16
		360	00
Azimuth CD	=	10	16
		180	00
Angle CDE	=	60	20
Azimuth DE	=	250	36

To obtain the bearings from the azimuths is simple, as the following will show:

When the azimuth is from 0 to 90° azimuth = N.E. bearing.
When the azimuth is from 90 to 180° 180 — Az. = S. E. bearing.
When the azimuth is from 180 to 270° Az. — 180 = S.W. bearing.
When the azimuth is from 270 to 360° 360 — Az. = N.W. bearing.

Station and Level Designations

All stations are numbered by numbers stamped on 1¼-in. copper disks, which are nailed to the plugs or caps. Aluminum tags soon become covered with a white coating, probably a sulphate of aluminum, making it difficult and sometimes impossible to read them. Stations on each level are numbered from zero up in the order in which they are put in, and in the case of replacing a station an entirely new number is used to avoid confusion.

Drifts and crosscuts are plotted on the mine maps once a month from rights and lefts taken at that time. This can be done most rapidly by using four men. Plumb-bobs are hung from two stations and the tape stretched between them and held. The third man measures the distance from the tape to the walls of the drift with a stick graduated to feet and calls them out to the fourth man, who records them along with distance of each reading from the starting point and the name of the level drift and stations used. A record will read as follows:

370 LEVEL, N. 600 W. 400 N.
Stations 69-70

Distance from Station, Ft.	Distance to Left, Ft.	Distance to Right, Ft.
10	2	3
25	4	2
30	6	1
50	10 S.E. cor. raise	3
54	2	3

Stopes are measured up every few days and sketched on cross-section cards carried in a loose-leaf holder. These are then transferred to the office maps and the cards filed.

Up to the present time there have been about three thousand working places in the mine, and this necessitates a certain definite arrangement both for matter of record and to designate the working. The levels are named from the distance they are to the surface in the shaft that first entered the orebody. A zero point was established on all levels at this shaft and the workings named in accordance with their relation to it. The name of each working is composed of three parts—first, the level; second, the distance north, east, south, or west from the zero point, and, third, the direction in which the heading is being driven.

Following are the names of some of the drifts: 370 Level E 200 N; Level E; Level N 300 W 50 E; Level W 150 S.

If the footage of each drift were measured from the intersection of the coördinates at its starting point, it would result in double-measuring every crossing. To obviate this, the workings running north and south or east and west from the zero point are measured from that point and all others from the sides of the drift from which they start. This also renders it possible for the samplers to measure and sample the drifts before transit lines are put in.

Vertical raises are measured from the top of the rail in the drift from which they start.

Mapping and Office Kinks

Assay plans and sections made on a scale of 40 ft. to the inch will enable the assay percentages to be entered inside of the lines of the drifts in case such percentages do not consist of more than three figures. At this property assay plans are made of each level and sublevel, and vertical sections are made on the 50-ft. coördinates each way. These sections face the east and north.

As the greater part of our tracings are used for the purpose of making blue or white prints, colored inks are not used on them with but one exception. Old timbering that is to be replaced is sometimes represented by green ink lines. These show as faint blurred lines on the blueprints.

Where very many tracings are to be made it will pay to buy tracing cloth cut in sheets, with the border, title, and even the coördinates, printed. The cloth costs but a few cents a sheet, and besides the saving in time will

more than pay for itself in the saving of tracing cloth ordinarily lost in cutting.

All paper and tracing cloth shrink after being unrolled, due probably to the tension applied in rolling them up. For large tracings or drawings where accuracy is necessary cut the paper or cloth to the required size and leave it loosely rolled for several days before using. In the case of tracing cloth, strip off the selvage edges before setting it away.

To plot coördinates, lay off one of the lines and erect two perpendiculars to it at opposite ends of the drawing; measure equal distances along these perpendiculars and draw a fourth line parallel to the first completing the quadrilateral. Check this up, subdivide the sides and draw in the coördinates. If this is not all done at one sitting the coördinates will be found to be out, as the paper or tracing cloth will stretch or shrink from day to day, especially during changes in the weather.

Blueprint papers vary in cost, due principally to the quality of the paper used in its manufacture rather than to any difference in the emulsion used. Some of the cheap papers are not tough and tear easily when wet. Blueprint papers are classed as rapid, electric-rapid, or regular, according to the time necessary to print them. In bright sunlight this varies in this locality from 3 min. for the regular to 20 sec. for the electric-rapid. By using the latter a saving in time is effected and prints can be made quickly on cloudy days if required. More care must be taken in using the more rapid papers to keep them from being exposed, so they do not keep so well as the slower kinds.

Direct black-print papers and cloths are printed directly from the tracings, and after being finished by washing in water give blue-black lines on a white background. They are much more expensive than blueprint papers and cloths, but are very useful for many purposes. Additions in pencil or drawing inks may be made to these prints, and they may be colored with either water colors or crayons. Black-print papers and cloths require from 4- to 8-min. exposure in the sun—the cloth a little longer than the paper; and it is not usually advisable to try to get a print on a cloudy day. Under-exposure leaves the ground purple after washing and in an over-exposed print the heavy lines are a light gray and the light ones print out. All white-print paper I have used becomes brittle if kept several months before using. Most, if not all, of this paper is imported from Germany, and the difficulty in obtaining paper that has not been kept in stock until it is brittle and worthless has kept many from using it. Apparently the cloth does not deteriorate with age.

An easy and rapid way of coloring white prints and drawings is by the use of wax crayons and gasoline. Go lightly over the space to be colored with the crayon, moisten a piece of cloth with gasoline and by rubbing it over the colored surface smooth the color and extend it to the edges of the space to be colored. If the color is smeared beyond the required limits it can be removed by a pencil eraser. The probable explanation is that the crayon, being a mixture of wax and ground pigment, has the wax dissolved by the gasoline, which leaves the pigment as an impalpable powder to be rubbed evenly over the surface. Some colors work much better than others, namely, the yellows, purples, slates and greens.

Convenient weights for holding down drawings can be made from 4x4-in. canvas bags filled with shot.

In an office of any size much time can be saved by the use of a tracing table. This consists of a glass-topped table under which are placed several large electric lights (we use 100-watt tungstens). With this it is even possible to trace through heavy cloth-backed drawing paper. The number of uses to which such a table may be put will be found to increase from day to day.

When it is necessary to put coördinates on a tracing it will be found advisable to place them on the opposite side of the cloth from the rest of the map. If this is done the coördinates will not be affected by any erasures.

These comprise some of our methods in use at the present time, for they are constantly changing. Frequently slight modifications are made to adopt a better method to our particular needs. Often a better procedure is adopted and more rarely a new one is originated and developed.

Missouri's New Mining Law

By A. L. H. Street*

At the recently adjourned session of the Missouri Legislature the mining laws of that state were increased by several different acts. One of the measures provides for official inspection of mines other than coal mines, to determine whether dust is present in the air in quantities injurious to miners. If such a condition is found, provision is made for requiring the owner or operator to install and maintain an independent water line, fully equipped and in good serviceable working order, leading up to the face of any and all drifts where such dust is produced, or so close to the face of the drifts that by the use of suitable hose extension or sprinkling attachments (to be supplied by the owner of the mine), the mineral or earth in and adjoining the face of the drifts can be sprinkled by water from the pipe line. It is made the duty of every person drilling, squibbing or blasting in such mine to keep the face, surface and drill holes in such drifts moist to such a degree as to prevent as far as possible dust rising from the workings. Violation of any provision of this act is punishable by a fine of from $5 to $50.

Another law requires owners and operators of lead and zinc mines to provide suitable dressing rooms with lockers for the use of employees. Adequate washing facilities and benches must also be afforded, and the rooms must be kept properly heated. A fine of from $5 to $25 may be assessed for disobedience of this act. Under a separate act, owners or operators of lead and zinc mines are bound to provide sanitary drinking devices if 10 or more men are employed.

Another law makes it the duty of the chief state mine inspector and his assistants to stop the operation of any mine or part thereof, where poisonous damps exist, where rotten ropes or unsafe cages are used or where a safe escapeway is not provided for all employees. A penalty of fine or imprisonment, or both, is prescribed for infractions of this act.

The Dexter White Caps Mining Co. of Manhattan, Manhattan, Nev., for the year ended Mar. 31, 1915, reports a production of 3406 tons of ore having a gross value of $36,272. The receipts from the sale of ore and royalties amounted to $45,867. The expenses were $65,683, thereby making a deficit of $19,816. Current liabilities amounted to $17,669 over current assets.

*Attorney, St. Paul, Minn.

Details of Milling and Smelting

Smelting Storage-Battery Sediment

By Walter C. Smith*

Several years ago I had occasion to treat considerable storage-battery sediment or mud in a 40-in. circular lead blast furnace. The charge for furnace averaged 850 lb. of ores, fluxes and returned slags. Fuel varied from 10% to 14% of weight of charge.

With normal conditions we had little or no trouble from the furnace top working hot, but whenever the charge carried 100 lb. or more of battery sediment the furnace would develop a hot top. Increasing the percentage of coke, lowering the blast pressure or wetting down charges would not correct the hot top. The furnace ran well, the slags were hot, tuyeres were bright, and had plenty of coke at tuyere level. By substituting any other lead-bearing material for battery sediment, the top would cool rapidly; replacing battery sediment on charge would, within one hour, develop a hot top accompanied by heavy fume losses.

The cause of this hot top was a matter of some discussion, the conclusion being that battery sediment, consisting principally of lead peroxide (PbO_2), breaks down under moderate temperature into litharge (PbO) and oxygen (O_2). This liberated oxygen immediately combines with CO in gases to form CO_2 and generates a large amount of heat at or near top of charge, thereby rapidly heating charge until a hot top develops, with no apparent increase of fuel consumption.

To prove this a small amount of battery sediment was slowly heated in a tube; well below a red heat, the reddish-brown PbO_2 changed to yellow PbO and a test of the gas showed the presence of large amounts of oxygen.

I finally treated battery sediment as follows: First, adding 75 lb. or less to each charge, wetting charge thoroughly; second, heating sediment in roasting furnace or kettle until it had turned yellow and then charging into furnace as lead ore.

Delta Crucible Tongs

The New Jersey Foundry & Machine Co., of 90 West St., New York, has put a new type of crucible tongs on the market which is so constructed as to take a six-point bearing on each side of the crucible, regardless of wear. This is attained by having three curved plates mounted on a three-armed frame, which has play enough in its mounting always to bring these three plates against the crucible.

In addition each of the plates has a concave surface, and this, with a little play in the individual mounting, insures a bearing of at least two points for each plate. This sextuple bearing should eliminate a great deal of premature cracking of crucibles through poorly fitting tongs.

*Silver-refinery superintendent, Chrome, N. J.

Smelting Data of British Columbia Copper Co.

Frederick K. Brunton, in describing* the British Columbia Copper Co.'s smelting plant at Greenwood, B. C., gives some interesting operating data of that works prior to its closing in 1914 on account of the decline in the price of copper. The company smelts the lowest-grade ore of any North American smelting works, the average copper content being 0.85%. The plant treats about 2250 tons per day, or 17.5 tons per man per day.

The equipment includes three blast furnaces and two converting stands. Two of the blast furnaces are 51x360 in. at the tuyeres and the other is 51x240 in. The vertical distance from feed floor to the center of the tuyeres is 16 ft. The 30-ft. furnaces have 72 tuyeres, 4 in. in diameter but bushed to 3¼ in., and receives about 25,000 cu.ft. of air per minute at 16- to 24-oz. pressure.

A typical furnace charge is shown in the accompanying table. The most variable factor is the Motherlode ore, which sometimes changes abruptly from a lime gangue to an iron gangue carrying about 30% magnetite, so that the furnaces require constant watching. The 5000-lb. charge shown gave 4300 lb. of slag that would carry 0.23%

TYPICAL FURNACE CHARGE AT GREENWOOD, B. C.

Ore		SiO_2 Per Cent.		Fe Per Cent.		CaO Per Cent.		S Per Cent.		Cu Per Cent.	
	Lb.		Lb.		Lb.		Lb.		Lb.		Lb.
Motherlode	2500	32	800	18	450	22	550	2	50	1.0	25.0
Rawhide	1600	36	576	16	256	19	304	3	48	1.2	19.2
Napoleon	500	30	170	30	150	7	35	17	85	0.2	0.5
Republic, SiO_2	400	80	320	..	...	7	28	..	..	...	....
Total	5000	..	1846	...	853	..	917	..	183	...	44.7

Cu, or about 10 lb. of copper, leaving 34.7 lb. for the matte, which required one-fourth of its weight, or 8.7 lb., of sulphur. By reason of the poor construction of the furnaces for handling ores so low in sulphur, 88%, or 160 lb., of the sulphur was volatilized in the furnace, leaving 23 lb. for the matte. Since the copper took 8.7 lb. of sulphur, there was left for iron 14.3 lb. of sulphur, requiring 1.75 times its weight, or 25 lb. of iron. The matte, therefore, contained: Cu, 34.7; S, 23.0; and Fe, 25.0 lb., and assayed 42% Cu. The slag ran approximately as follows: SiO_2, 42.7; Fe, 19.7; CaO, 21.2; Al_2O_3, 9.0; and Cu, 0.23%.

FURNACE OPERATING DATA

Tons smelted per day	2250.0
Tons smelted per square foot of hearth area, average	6.62
Tons smelted per square foot of hearth area, maximum	8.70
Tons smelted per man per day	35.70
Cu on charge, per cent	0.8 to 1.2
Cu in matte, per cent	30.0 to 45.0
Cu in slag, per cent	0.22 to 0.27
S on charge, per cent	2.00
S burnt off, per cent	85.00 to 90.00
Coke used on charge, per cent	12.00 to 14.00
Coke ash, per cent	20.00 to 28.00
Blast, cubic feet per minute	25,000
Cooling water for jackets, gallons per minute	2,500
Men per 8-hr. shift	21.0
Matte, per cent. of total charge	1.65
Slag, per cent. SiO_2	38 to 45
Slag, per cent. Fe	13 to 20
Slag, per cent. CaO	20 to 26
Slag, per cent. Al_2O_3	6 to 9

* "The British Columbia Copper Co.'s Smelter, Greenwood, B. C.," a paper to be read before the San Francisco meeting of the American Institute of Mining Engineers, September, 1915.

The labor required in the furnace department per shift is: One shift boss at $5.25, three furnacemen at $4, three furnace helpers at $3, one slag motorman at $3.40, one slag switchman at $3, three charge motormen at $3.15, three head loaders at $3.15, three second loaders at $3, one feeder at $4, one bin man at $2.75, one power-house man at $3.40—a total of 21 men and of $70.70 in wages per shift. In addition there are on day shift only, four men in the briquetting plant and four men on slag-track grading at a total daily wage of $23.50. These two crews are used when needed in general roustabout work so that not all of their time was really chargeable to furnace work.

Powdered Coal

At the seventh annual convention of the International Railway Fuel Association, W. L. Robinson, supervisor of fuel consumption of the Baltimore & Ohio R.R., presented a paper outlining the advantages that might result from the use of powdered coal in locomotive furnaces, from which the following costs of pulverizing are taken:

The cost of preparing powdered coal will vary with the cost for the raw coal and its moisture content. However, a general average from available data covering periods of the past five to ten years at cement and metallurgical plants has made it possible to present the following conservative estimate, assuming the cost of the raw coal at from $1 to $2 per short ton, and that it will require crushing and have a moisture content of from 5 to 10 per cent. when placed in the drier:

Capacity of Plant in Short Tons per Hour	Average Total Cost for Preparation per Short Ton
2	From 25 to 50c.
3	From 20 to 45c.
4	From 16 to 40c.
5	From 14 to 35c.
10	From 12 to 30c.
25	From 10 to 20c.

The fuel required for drying the coal will average from 1 to 2% of the coal dried. The distribution of the total may be approximately stated as follows:

Fuel for drying	10%
Power for operation	30%
Labor	30%
Maintenance and supplies	25%
Interest, taxes, insurance and depreciation	5%
Total	100%

The cost of preparing powdered coal should be more than offset by the ability to utilize mine refuse and sweepings, run-of-mine, screenings and slack grades of coal that cannot be used to good advantage otherwise, and inferior grades of sub-bituminous coals, lignite and peat of relatively lower cost per ton than the readily salable commercial fuels.

Coal in a finely divided or powdered state represents the most advanced method for producing perfect combustion. While a cubic inch of solid coal exposes only 6 sq.in. for absorption and liberation of heat, a cubic inch of powdered coal exposes from 20 to 25 sq.ft., which enables the more uniform gas production from the volatile matter in the coal and the more prompt and perfect intermingling of gas and air, thereby improving combustion and reducing smoke. Furthermore, there is no cooling of the fire by heavy intermittent charges of fresh coal, as is the case with hand or stoker firing on grates.

Powdered coal may be burned by either of two generally defined methods—the long-flame method, constituting a progressive burning of the coal such as is employed in cement and openhearth furnaces, and the short-flame method, which is the latest development and is used in metallurgical and similar metal-heating work or under boilers where a similar furnace volume obtains.

Welding Up Scrap Nickel Anodes*

Some important experiments in the welding of nickel anodes by the oxyacetylene process have just been concluded in the large plating department of the Prest-O-Lite Co., Inc., at its Indianapolis plant.

The anodes used by the Prest-O-Lite Co., Inc., are castings of 90% nickel, 8% carbon and 2% iron. They are elliptical bars, approximately 1½x3½ in. in cross-section and 30 in. long, and weigh about 30 lb. Their market value varies between 46c. and 50c. per lb.

By welding up old anodes which have been in the solution, and which have a junk value of between 22c. and 25c. per lb., the company is now converting its entire pile of scrap nickel into what are practically new anodes at a total cost for gas and labor of less than 6c. per lb. This estimate is based on a recent test at Indianapolis in which 421 lb. of scrap anodes were welded up at the following cost:

463 cu.ft. oxygen, at 2c.	$9.26
480 cu.ft. acetylene, at 2c.	9.60
24-hr. labor, at 25c.	6.00
Total	$24.86

In view of the fact that this test was made before any experience in the operation had been gained, it is apparent that better results and greater savings are sure to be the result of practice.

The method of handling this operation is about as follows: As the anodes are eaten away by the solution they are turned over to an oxyacetylene welder, who "tacks" on scraps of old anodes by welding to increase the surface.

The welding flame is also employed to remove the brass hooks which are used to support the anodes while in solution. Under the intense heat of the oxyacetylene flame (approximately 6300° F.) the solder melts away rapidly, leaving a pure nickel bar, which is later welded up.

No flux is employed, as this has been found to be unnecessary. The pieces of scrap are simply melted on or "fused" together, using another piece of nickel as a filling rod. The welding process is a great benefit in obtaining perfect fusion, which is essential, as all joints must have electrical conductivity equal to that of new anodes.

Another great advantage is the fact that no skill or experience in the art of oxyacetylene welding is required to weld up scrap nickel anodes; in fact any workman with average intelligence can do the work without any previous knowledge of the process. The apparatus needed to do the work is inexpensive.

Many other attempts have been made to utilize scrap nickel anodes, the most common practice being to drill holes through several pieces and bind them together by means of lead rivets. This method depends on the contact of the wire or rivet and the piece of scrap to conduct the current, and is therefore of uncertain value, and in many cases a flat failure. If for any reason the contact is bad and offers too much resistance to the current of electricity, the metal will not dissolve.

*From data furnished by the manufacturers.

The Cost of Doing Things

La Rose Consolidated

The La Rose Consolidated Mines Co., Cobalt, Ont., shows a combined profit of $208,939 for 1914 and dividend payments aggregating $771,000. Shipments totaled 1995.4 tons, averaging $333.20 in value per ton, after deducting $90,584 for smelting charges. The total reported cost of producing silver was 37.2c. per oz., made up of 23.08c. for mining, 9.69c. for concentrating, 7.42c. for marketing, 0.77c. for depreciation, 0.09c. for general expenses, and 0.64c. for advances to the University mines—a total of 41.69c., less a credit of 4.49c. for ground rents, discount and interest. The marketing expense was made up of 5.07% of the gross value of the ore for deductions on silver, 4.39% for treatment charges, 2.85% for freight and 1.65% for assaying and sampling, etc., or 13.96% total, based on $727,075, the gross value of the ore, including cobalt, paid for. Dividends paid to date by the La Rose Mines amount to $6,579,409 and by the La Rose Consolidated, $5,162,326. The mill treated 54,020 dry tons of ore and produced 1,271.76 dry tons of concentrates containing an average of 443 oz. of silver per ton. The average assay of mill heads was 13.12 oz., and tailings averaged 2.75 oz., indicating an extraction of 79.5%. Mill costs were $2.45 per ton milled. Ore reserves are estimated to contain 47,464 tons having a net value of $166,784. It is stated that the property has been almost exhausted of high-grade ore.

East Butte

The East Butte Copper Mining Co., Butte, Mont., for 1914 reports a net surplus of $222,252 on operations. Copper production amounted to 9,175,579 lb. from 72,853 wet tons of ore, or 71,918 dry tons from the company's mines, and 39,074 dry tons of custom ore. There were also produced 242,347 oz. of silver and 2219 oz. of gold. The gross value of metals shipped was $1,291,675, and other income amounted to $163,779, which made a total income of $1,455,454. Operating expenses amounted to $1,048,856; interest payments, $36,500; depreciation and losses, $11,744; additions to equipment, $71,002; and exploration and development, $65,099. The cost per pound of copper was 11.11c. Mining, including development, averaged $5.39 per ton of ore. The main shaft was sunk 185 ft., making a total depth of 1770 ft. Owing to the war the property only operated 220 days in 1914.

International Nickel

The report of the International Nickel Co. for the year ended Mar. 31, 1915, shows a net profit of $5,598,071, after deducting all expenses, depreciation, exhaustion of minerals and all other charges. During the year $595,976 was expended for additional property. Dividends amounting to $534,756 were paid on preferred stock and dividends on common stock aggregated $4,753,937. The consolidated balance sheet shows current assets of $11,117,881 and current liabilities amounting to $2,770,073. The number of stockholders increased from 3752 to 4465 during the year.

Chino Copper in 1914

The report for 1914 of the Chino Copper Co., Hurley, N. M., shows a production of 53,999,928 lb. of copper from 1,926,705 tons of ore. Dividend payments amounted to $2,169,065, while the actual amount available for dividend payments from 1914 operations was $2,298,246. The mill treated 1,907,300 tons averaging 2.1151% copper, and 19,405 tons were shipped direct to the smelters. The average net yield in refined copper per ton of ore was about 28 lb. The accompanying table gives a summary of Chino's production for the last three years:

Year	Tons of Ore Treated	Yield of Refined Cu per Ton	Total Lb. Refined Cu Produced	Ore Reserves — Tons Ore	Ore Reserves — Average per Ton
1912	1,122,666	24.7 lb.	27,776,088	90,000,000	36 lb.
1913	1,942,700	26.0 lb.	50,511,661	90,000,000	36 lb.
1914	1,926,705	28.0 lb.	53,999,928	90,270,155	35 lb.

The company owns 2645 acres of mining claims, of which 2412 acres are patented. In addition to this land the company owns 160 acres of agricultural land adjoining its mining claims. Including various water rights in connection with its mill site, the company also owns or controls 18,074 acres at Hurley. There were issued 9400 shares of capital stock during the year for the conversion of the remaining outstanding first mortgage bonds. The total outstanding capital stock now amounts to 869,940 shares. Dividends to date have aggregated $4,088,135. The profit as shown in the report for 1914 was $3,222,579, but other expenditures for deferred operations, bond redemption and investments reduced the amount available for dividends to $2,298,246 as shown in the following statement, which has been prepared in order that the financial transactions as shown by the statements in the report may be easily understood:

TOTAL RECEIPTS AND TOTAL EXPENDITURES OF THE CHINO COPPER CO. DURING 1914

Receipts		
From sale of metal products		$7,247,197
From miscellaneous sources		179,588
From capital stock at par value		47,000
From premiums on sale of capital stock		187,850
Total receipts from all sources		$7,661,635
Expenditures		
Expenditures charged to operations	$4,172,374	
Bond interest and advances paid	31,832	
Property account	1,645	
Construction and equipment	400,625	
Development	34,553	
Deferred stripping	484,178	
Investments	1,680	
Bonds redeemed	236,500	
Total expenditures	$5,363,388	
Paid out in dividends	2,169,065	
Added to quick assets	129,182	
To balance with total receipts		$7,661,635
Balance of quick assets at end of 1913		$2,298,529
Balance of quick assets at end of 1914		2,427,711
Increase in quick assets in 1914		$129,182
Dividends paid in 1914		2,169,065
Amount actually available from 1914		$2,298,247

ANALYSIS OF TOTAL RECEIPTS AND EXPENDITURES

Receipts from operations—current and deferred:		
From sale 53,999,928 lb. of copper at 13.325c.		$7,195,423
From gold produced		51,774
From miscellaneous income		179,588
Total operating income		$7,426,785
Current operations:		
Mining and milling	$1,473,553	
Treatment, refining, freight	2,048,004	
Selling commission	72,805	
Stripping	578,012	
Total operating costs reported		4,172,374
Total income reported		$3,254,411
Less interest and advances paid on bonds		31,832
Net profit shown in report for 1914		$3,222,579
Deferred expenditures to operations:		
For property account	$1,645	
Construction and equipment	400,626	
For development	34,553	
For deferred stripping	484,178	
Total deferred charges to capital accounts		$921,002
Balance over current and deferred expenditures		$2,301,577
Other expenditures:		
Bonds redeemed	$236,500	
Investments	1,680	
	$238,180	
Less receipts from capital stock	234,850	
Net amount paid out from earnings		3,330
Amount from 1914 actually available		$2,298,247
Dividends paid		2,169,065
Balance added to quick assets		$129,182

The total amount of ore and waste removed by steam shovels was 4,192,009 cu.yd. of material in place; 3,173,717 cu.yd. of this was stripping and the remainder was equivalent to 2,114,910 tons of ore. All material removed to date by steam shovels amounts to 13,014,416 cu.yd. in place, of which 10,188,246 cu.yd. was stripping, and the remainder was equivalent to 5,770,356 tons of ore. Of this ore 720,295 tons has been stored in the stock pile. The average cost of steam shovel work was 36.52c. per cu.yd. for all material moved during the year. The cost of handling waste alone was 33.47c. per cu.yd. The cost per ton of waste handled was 16.12c., while the cost of handling ore was 22.13c. There is a total of 24.039 miles of track used in and about the mine in connection with steam-shovel work, of which 23.223 miles was in use on Jan. 1, 1915.

During the first seven months of the year the mill operated 95.3% of possible time for all sections. Owing to curtailment on account of the war, the mill was operated on 66% of possible time during the remaining five months. During the first period the mill averaged 1345 tons per day per section and 1085 tons for the five-month period. During the year the entire plant averaged 5225 tons per day and treated 1,907,300 dry tons. A total of 147,925 tons of concentrates was produced, which corresponds to a ratio of 12.89 tons of ore to 1 of concentrates. The average grade of concentrates was 18.505%, and the mill extraction was 67.858%. The average milling cost was 55.01c. per ton of ore.

Ore reserves are estimated to contain 90,270,155 tons of fully developed ore averaging 1.75% copper. On the basis of operating costs reported, which do not include depreciation, the net cost of producing copper after crediting gold contents and miscellaneous earnings was 7.35c. per lb. as compared with a cost of 8.5c. per lb. reported for the previous year.

⁂

The Franklin Mining Co., Houghton, Mich., for 1914 reports that the only production for the year came from the test-sampling of 7324 tons of rock, which yielded 93,283 lb. of copper. The total expenses were $140,018, and receipts amounted to $357,449, including assessments Nos. 1, 2 and 3. After deducting a deficit for 1913 a balance of $117,165 remained in the surplus account at the end of the year.

Tennessee Copper Co. in 1914

The report of the Tennessee Copper Co., Copperhill, Tenn., for 1914 shows a production of 12,871,113 lb. of refined copper from 485,051 tons of company ore smelted. Net profits for the year, including acid-plant earnings and earnings from all other sources, amounted to $751,893.

This amount was distributed as follows: Dividends, $600,000; reserve for general depreciation, $100,000; reserve for Federal income tax, $1126; and addition to surplus account, $50,767. Dividends to date aggregate $4,465,250. A record of the production from the company's ore for 1901 to 1914 inclusive shows that 4,978,349 tons of ore have been mined, 4,961,673 tons smelted and 155,493,546 lb. of copper produced. Ore reserves are estimated to contain 5,390,661 tons averaging 26.54 lb. of recoverable copper. The cost per ton of ore, not including refining, was $2.74725 made up as follows:

	Per Ton
Mine development	$0.04957
Mining	.97813
Railway expense	.05027
General expense	.18932
Smelting expense	1.31677
Converter expense	.16319
Total	$2.74725

The total cost of producing refined copper was 11.40c. per lb., not crediting the sales of sulphuric acid nor the values of copper in flue dust. The acid plant produced 210,163 tons of 60° Baumé acid. The smelting plant treated 724,822 tons of ore and flux with 38,726 tons of coke. The company has now reduced its bonded indebtedness to $800,000. It now has about 2000 stockholders.

⁂

Tamarack

The Tamarack Mining Co., Calumet, Mich., for 1914 reports a production of 1,074,808 lb. of copper which it sold for 12.8c. a lb. The mine operated at a loss of $174,908. The following table gives a comparison of operations for the last four years:

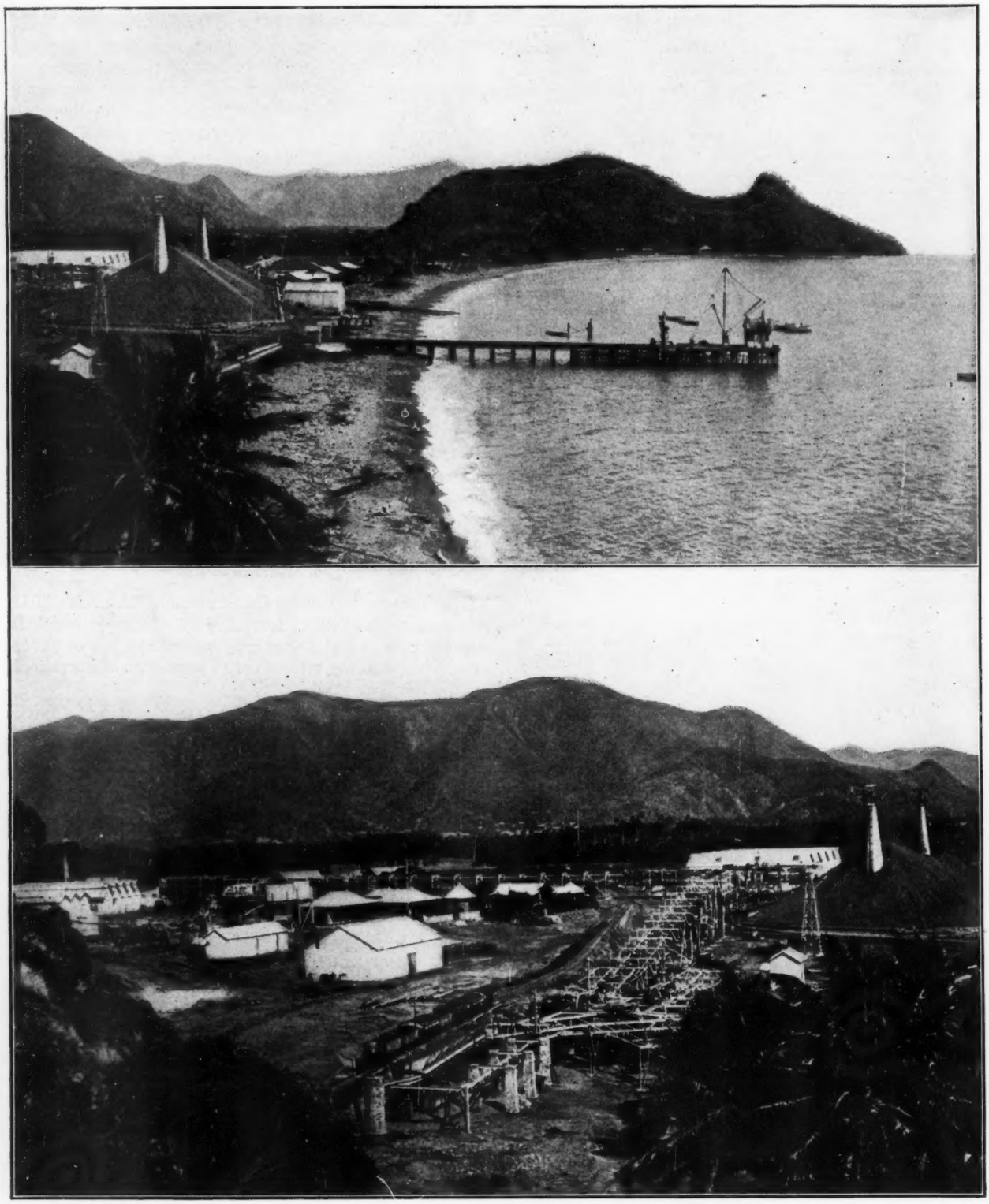
	1911	1912	1913	1914
Tons of rock treated	392,338	421 385	227,563	57,410
Pounds of mineral	12,793,430	12,118,038	6,206,295	1,743,145
Pounds of refined copper	7,494,077	7,908,745	4,168,743	1,074,808
Per cent. of refined copper in mineral	58.58	65.26	67.17	61.66
Refined copper per ton of rock treated, lb.	19.1	18.8	18.3	18.7
Cost per pound:				
Mining	14.07c.	11.90c.	15.35c.	24.00c.
Construction	.06c.	....	....	3.28c.
Smelting, freight, commissions, office, etc.	1.23c.	1.11c.	1.25c.	1.80c.
Interest	.20c.	.14c.	....	....
Total cost per lb.	15.56c.	13.15c.	16.60c.	29.08c.
Cost of mining, transportation, stamping and taxes, per ton of rock	$2.69	$2.23	$2.81	$4.49

⁂

Beaver Consolidated

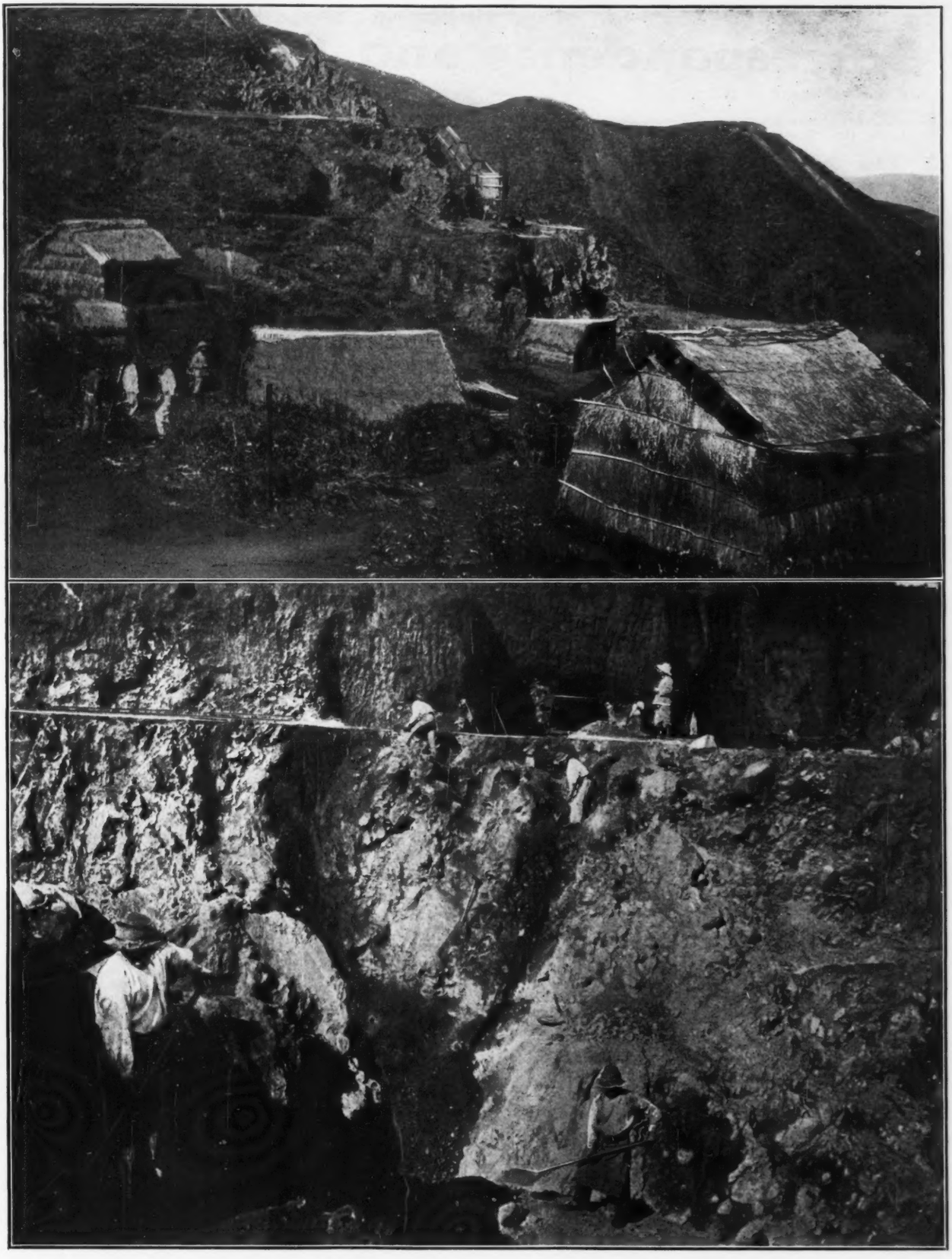
For the year ended Feb. 28, 1915, the Beaver Consolidated Mines, Cobalt, Ont., shows a production of 900,000 oz. of silver, of which 390,878 oz. were sold. The remainder was held in storage by the smelters. The mill treated 26,724 tons of ore, from which 347.95 tons of concentrates were produced containing 415,707 oz. of silver. A profit of $254,768 is shown in the financial statements before providing for depreciation amounting to $13,728. Dividends for the year amounted to $60,000. The cost of production was 21.54c. per oz. of silver.

Photographs from the Field



"LE NICKEL," NEW CALEDONIA

Famous nickel mines controlled by a French company. The upper view shows the shore and landing at La Mission, the town embracing the company's plant. The lower view shows the works



"LE NICKEL," NEW CALEDONIA

Two views of the Bornet mine, near La Mission, New Caledonia. Mines are connected with the works by a 17-km. aërial tramway over which 60,000 tons yearly are transported. The pylons are 22-25 m. high. The company has refineries at Havre and Glasgow

Correspondence and Discussion

Tin Smelting in Bolivi

I refer to the editorial comment on the article by Mr. Lamb in the JOURNAL of Apr. 3, 1915. As ex-director of the Departmental School of Mining and Engineering of the Republic of Bolivia I can assure the editor that any business in tin done by the Yankees in this country will have to be solely on the basis of properties owned.

The kind of mines which capitalists usually look for—those in working order and with developed ore—are not to be found in Bolivia. Here everybody lives from hand to mouth, without bothering about the morrow; and although one may wish to develop a mine properly, he will not find either competent technical direction or the capital or credit required. The result is that even the large businesses have not the intrinsic value which they appear to have, nor is there life or prosperity assured even for two or three years. Anyone who wishes to succeed here must force his future with his own hand, beginning with the clearing of the titles to property, rectification of boundary lines, investigations, preparation of mines and living quarters, and finishing with the necessary skill for ore treatment.

I know of virgin lands which are good and available for development on a large scale; I know also of abandoned mines which would provide a profit if they were properly developed. The sooner the problem is tackled the sooner and surer will be the success. One cannot lose by giving serious study to the problem and disregarding the gratuitous information given by travelers for pleasure. Anyone considering work of this kind should possess a knowledge of the Spanish language, in order to treat directly with the people, and also to be able to appreciate the value of the facts presented. If such person is capable, cultivated, and will come recommended to me, I will lend him my aid and experience and knowledge, together with much positive information.

Only a short time ago there arrived here a merchant who has passed through New York. Apparently enthused by the prospects which had developed for a tin market, he asked me for information about mines and mining business. From my point of view he was wasting time, and it is a loss of time to bother with going into details with people who are unknown. However I do not doubt that Mr. Burrage might have entered into a splendid business if he had installed his smelteries in Bolivia, taking advantage of the hydraulic power available—for example, that of Pilcomayo.

The greater part of our miners have no resources and are eternally pushed by necessity. Consequently, they deliver their products to the first buyer. Even the companies of some importance prefer to liquidate their concentrates or sorted ore to local buyers for cash, instead of waiting for the results of a sale in Europe, which, in normal times, means a delay of about five months. Taking into account the great saving of freight and insurances, saving in sacks, loss of mineral or ore, and penalties, more or less unjust, for moisture, etc., you can understand why a country which contains the raw material in abundance has not yet arrived at the solution of the problem of the metallurgy of tin. The truth is simply that we in Bolivia are the toy of circumstances and conditions will not change until intelligent technical and commercial skill, conscientious energy and capital in adequate quantities shall enter into and take part in our mineral industry.

JOSÉ JACKOWSKI.

Casilla No. 120, Potosí, Bolivia.

Difference in Buying Zinc and Lead Ores

The producer of small lots of lead ore (galena) throughout the Missouri-Kansas-Oklahoma district sells his output at a certain figure per 1000 lb. and usually gets as much as the operator who sells carload lots. But in the production of zinc ore a different condition entirely exists, the small producer invariably being forced to take a much lower price per ton than the larger producer. A striking example of the wide variation in price between small lots and carload lots of zinc ore has been noted recently since ore prices have soared to such high levels. Carload shipments of uniform grades of blende concentrate have brought as high as $135, basis of 60% metallic zinc, whereas the company selling only a few tons would receive only $85 or $90.

Why there should be such a wide variation in zinc and virtually no difference in lead is explained through the fact that all lead ores of this district respond to simple smelting processes, whereas there is a big difference in the various lots of zinc concentrates from the different small mines, and a conglomeration of such concentrates does not yield as readily to the zinc-smelting process as would concentrates more uniform in character. Zinc smelters do not like to purchase odd lots of concentrates for the reason that their retorts are adapted to a certain character of charge and by varying the metallic composition of this charge the highest efficiency in metal recovery cannot be attained, and also the life of the retort is shortened. This condition explains why the heavy producers of uniform grades of zinc concentrate find a ready market at good prices for their output, whereas the small producer sometimes finds it difficult to dispose of his product even at a greatly reduced price.

A uniform grade of concentrate, whether it be high or low, is the kind that finds the ready market. Certain smelters demand only those concentrates that run high in metallic zinc and low in iron and with a minimum or total absence of lead. The presence of iron is not so undesirable as lead and certain smelters prefer a low-grade concentrate with plenty of iron. Lead content in the zinc is undesirable to all smelters whether they are users of high- or low-grade concentrates.

Competitive bidding for district concentrates is the method of purchasing as there are no contracts in use.

Blende is sold on a 60% metallic basis; calamine on a 40% basis, and galena on an 80% basis.

Joplin, Mo., June 10, 1915. L. L. WITTICH.

Kitchen Assaying

Some months ago there appeared in the Situations Wanted column of a New York daily newspaper a notice to the effect that a certain lady was prepared to enter the service of a mining company. It appeared that her qualifications were almost unlimited, including bookkeeping, cooking, assaying, surveying, etc.

If there is to be any great demand for such versatile talent, the correspondence schools, publishers of cookbooks and editors of pin-money pages of the Ladies' Home & Camp Companion Journals should take such steps as may be necessary to disseminate useful information pertaining to the duties of those fortunate or unfortunate female persons who are compelled, either by their roving instincts or by the vicissitudes of fortune, to follow mining as a profession. As a hint the following sample is respectfully submitted:

RAPID COPPER ANALYSIS

Break the ore to about the size of half a thimble. Take four bread-pans and place edge to edge in the form of a hot cross-bun. Pour the ore gently with a slight tango-step motion, so that each pan will receive an equal share. Discard contents of two opposite corner pans. Mix contents of remaining two pans and repeat until about one large teacupful of ore remains. Pulverize in a clean coffee mill or meat chopper to fineness of percolator coffee. Mix thoroughly on oilcloth of kitchen table.

Take one leveled teaspoonful of the ore and place in a teacup. Add one tablespoonful of spirit of niter, a few drops of spirit of salt and a pinch of hyperoxymuriate of potash. Bring almost to a boil and then set (not sit) on the back of the range to simmer for about half an hour. Then add gently three dessert-spoonfuls of pure water. Allow to cool and add volatile alkali to suit smell.

Line a glass funnel with a cone of unsized paper porous enough to allow liquids to pass through it. Set the funnel over a milk bottle with a capacity of exactly one pint (this is perhaps 34.6592 cu.in. or possibly 28.875 cu.in., but the absolute value is unimportant).

Pour the contents of the teacup into the paper cone, leaving the dregs or grounds until the last pouring. Wash out cup with boiling water, adding the dish-water to the slops in the funnel. Keep on washing until the pint bottle is nearly full. A mark placed on the bottle will be found convenient to indicate the same quantity of liquid in each case.

To measure the percentage of copper in the ore a set of bottles should be prepared beforehand, using some ore that is known to contain an exact percentage of copper, such as 4%.

Use one batch for a 4% shade. Use another batch and add an extra pint of clear water and mix thoroughly. Then one pint of the mixture will give a 2% shade. Dilute the other pint again for a 1% shade.

For an 8% shade, use two teaspoonfuls of the 4% ore and double everything but the wash water, keeping the total liquid quantity down to one pint, or to the mark on the pint bottle. Beer bottles, whisky bottles, grape-juice bottles, etc., will serve, provided they are of clear glass without tint and all of the same size.

For those who find difficulty in understanding what "percentage of copper in an ore" means, a special recipe may be devised to show the number of grains, pennyweights, etc., in a stone of ore. Sugar is often sold by the stone, ¼ stone being 3½ pounds. So it will be an easy matter to balance the ore with four errands of granulated sugar. (When I was a little boy an errand of sugar was always 3½ pounds.)

Resuming the chemico-culinary topic, it may be stated that to guess the answer to a copper assay or analysis by this easy method one merely causes the sample bottle to promenade up and down the kitchen shelf opposite the stock set, and the color is matched as in selecting ribbons.

By this method a good consulting kitchen-mechanic can guess at the percentage almost as accurately as it can be estimated by a khaki-clad high-priced technical graduate.

T. MONTMORENCY DILLON,
Deficiency Engineer.

New York, June 20, 1915.

Correspondence-School Graduates

In much of the technical and pseudo-technical matter which I have written in the past have been injected a few bits of what was intended to be humor in order to relieve the monotonous tone which might otherwise have prevailed.

Some unkind person has suggested that I cherish a feeling of malicious hatred toward correspondence schools. The imputation is false. Correspondence schools have performed a great service for humanity and have also paid me real money for some of the text-books which I had the pleasure of writing and revising.

What I do abhor is a conceited dolt who, having completed a correspondence course, imagines his dictum to be the last word in science—the final test, as it were. Such a bore is immeasurably more insufferable than a recent college graduate who announces that he is about to put the world on the high-speed gear and cut out the muffler. The latter individual has enough sense to know that the world is "hep" to his game of bluff or else he is sufficiently congenial to "kid" the world into taking him seriously now and then.

The correspondence school question may be summed up briefly in a metaphor—the best incubator in the world will not hatch a cold-storage egg.

New York, June 8, 1915. WILLIAM B. MCKINLAY.

Belgian Trade after the War

I should like to inform the JOURNAL readers that several competent Belgian business men have created an organization having a double object: (1) To introduce in Belgium, as soon as the war is over, all American products and manufactures; (2) to employ as agents, representatives, etc., a large number of Belgian manufacturers and business men, who have been partly ruined but still possess enough capital and can give the necessary guarantees as agents, dealers, etc.

WILLY LAMOT.

Shardhighs, Halstead, Essex, England, June 1, 1915.

Mining Conditions in China

By F. Lynwood Garrison*

SYNOPSIS—Consideration of some established facts about the Chinese and their country. Its civilization is the most ancient and its people have developed an anti-military spirit. The country has great agricultural and mineral resources, and economic awakening is likely to make it one of the most important.

The present visit of the Chinese Trade Commission to the United States is likely to renew interest and stimulate our desire to know more of the mineral resources of that great country. As has always been the case when educated Chinamen honor us with a visit this commission is making a most excellent impression upon all who have been so fortunate as to meet its members.

No one who has lived and worked in China, who has striven to know its people and understand their views of life, can have failed to be impressed most favorably by their high character as well as their soundness and saneness of intellect. Despite the fact that my own work in China was cut short by the Boxer troubles of 1900, my interest in this great people has not ceased or flagged, and I have never had reason to change the high opinion of their character first impressions gave me. But in order better to understand the Chinese and China it is desirable, even at the risk of restating well-known facts, for us to consider a moment certain fundamental conditions that are essential to a proper appreciation of the subject as a whole.

Antiquity of Chinese Civilization

Chinese civilization has endured for something like 5000 years. Had the oldest of the other civilizations, the evidence of which archaeologists are now digging up out of dust heaps, endured to the present it is doubtful if any of them would be as old today as is the Chinese nation. Notwithstanding this great age, the Chinese continue to be a strong and virile people; how strong and how vigorous one needs to have lived among them to realize fully and to appreciate that antiquity does not necessarily connote decadence, or that ingrained distrust and disgust for militarism indicate degeneracy. The Chinese in a sense have always been an essentially agricultural people; despite the fact that a few notable mechanical inventions appear to have had their origin with them, the mechanic arts as such appear never to have flourished, to have been encouraged or to have played any notable part in the history of Chinese civilization. Herein lies the essential difference between Oriental and Occidental, or perhaps it would be more correct to say between Mongolian and European, culture, and it brings us to a realization of how this terrible war in Europe is mocking us.

Have we not with smug complacency been sending for many years missionaries to the "heathen" Chinese, and on the whole have they not been kindly received? The Chinese tell us: "These missionaries are very good people, they help us in many ways, and we welcome them, for they heal our sick, cure our maimed and teach our children many useful things; but we are not perfectly sure their ethical views and understandings of life are any sounder or better than our own. With your machines you can do many things we cannot, and you have thus added vastly to your personal comforts and wealth, but we are not certain that in consequence you are any happier or better off. Your educational system is perhaps a stupendous success if the world is to be simply a factory, but we fear it may prove a monstrous failure if the object happens to be more than that. In short, does your Western system of education give sanity to life or even protect it?"

I profess no greater insight into the oriental mind than that possessed by the average Westener, but it seems to me not so difficult to get some fleeting glimpses into its depths if we take the trouble. We all know in our hearts that might as expressed by mere physical force is not necessarily right, and that defenseless China of today is the only great nation in the world that does not believe in physical force as a vehicle through which to assert might. The Chinese do not now and never have asked anything of the world but to live and let live in peace. But that it is a fatuous, dangerous policy in this present state of world civilization we are all now willing to admit. That the Chinese may change this policy and become part of the restless, ruthless mechanical world is not altogether improbable, although I myself believe and almost hope it is unlikely. With this theme in mind let us briefly consider a few facts regarding the natural resources which China can call upon when she sees fit to change her economic policies.

Geography and Topography of China

China with its dependencies has an extent of something like 4,000,000 square miles, and as every geologist knows no such great area of the earth's surface traversed by great mountain chains and intersected with large river valleys exists that does not give promise of extensive mineral deposits. The area of China proper is about 1,400,000 square miles, 200,000 of which are comprised within the alluvial plains of the Yangtze and Yellow Rivers; the remaining 1,200,000 is hilly or mountainous. It has been assumed by some writers that but little is known of the mineral resources of China. As I will endeavor to show, such is not the case, and their exploitation by the Chinese themselves is by no means a new thing. As long ago as the time of Marco Polo in the 13th Century, the Chinese were using what is described as "a black stone which they dig out of the ground and burn like firewood," which of course was coal, and its use thus far antedates any recognition of its value in Europe or in any other country. In fact, as a general statement it may be said that from time immemorial the Chinese have been utilizing their mineral deposits in a small way, but that it has only been within recent years they have come to any sense of realization of their extent and commercial importance.

Chinese Coal Deposits

About the first inkling the Western world received of the vast extent of China's coal fields was from the obser-

*Mining engineer, Philadelphia, Penn.

vations of the American geologist, Raphael Pumpelly, whose reports were published by the Smithsonian Institution in 1866. Three years previously this remarkable man ascended the Yangtze River to Central Hunan and to the frontier of Szechwan; in 1863-64 he examined the coal fields west of Peking and made journeys in northern China and southern Mongolia.

Pumpelly was followed a few years later (1870) by the German scholar and geologist, Baron von Richthofen, who spent many years traveling about China, and whose valuable observations and maps were published in five large volumes. Richthofen's deductions are in the main probably reliable, but the practical conclusions he drew therefrom are open to doubt. He was a geologist of profound learning and some of his work in this country, particularly that connected with the Comstock lode, is notably good.* Coal beds, especially those of anthracitic character, have a habit of faulting, folding and pinching out, or being eroded away, and Richthofen appears to have been somewhat misled in judging the volume and extent of such deposits by the size and character of the outcrops. Our American Government geologists did much the same thing in Alaska. Hence it is evident even the best of geologists and mining engineers, who are unfamiliar with coal mining and estimating, are likely to ascribe an undue continuity and size to coal beds when judged solely from superficial appearances. Moreover, few people realize that in many, if not most, coal-mining operations about half of the coal in the ground is wasted.

Within recent years (1903-04) Willis, Blackwelder and Sargent, working under the Carnegie Institution, Washington, carried out an extensive geological reconnoissance in China proper. Their excellent work was published in three large volumes by the institution in 1907, but is held for sale by this "impecunious" organization at such high prices as to be beyond the reach of the average purse. The work of these geologists is, however, so meritorious that it will doubtless prove to be an immense help in the future to mining engineers engaged in the development of the country.

Geological Characteristics

Bailey Willis likens North China roughly to the eastern United States, and South China to the Western states. The coal fields of Shansi resemble those of Pennsylvania and the gold-bearing rocks of Chihli those of the Appalachian Mountains. The Sierra Nevada and the Coast Range he likens to the Tsin range of Shensi and perhaps also the rocks of Yunnan, Kweichow and Kwangsi. He states there is no one region that may be characterized as especially rich in minerals.†

The central areas of China proper appear to be composed chiefly of the upper Paleozoic rocks, Devonian and Carbonifierous, and in the latter as well as in the younger Jurassic coal measures, we find the great coal beds which are certain to make China a tremendous factor in the economic history of the world. There has been so much idle talk in the newspapers on great fundamental conditions of this kind that one almost hesitates to refer to the subject, but nevertheless it is a fact which must be driven home and ever kept in mind, for it is as certain as anything can be that in the future the cheap fuel, cheap and efficient labor, and temperate climate, with the centers of trade and manufacture having free access to seaports throughout the entire year, present a combination of conditions of a most potential character. Add to this an abundance of fairly good iron ores, though rather lean as compared with American standards, the whole presents a field of possibility in this age of steel and cement the importance of which cannot possibly be overestimated. In Szechwan province there is also promise of oil and natural gas, but as yet I have not heard of any great gushers or naturally flowing wells having been tapped, although there is no reason to suppose they will not be in the future. The same geologic conditions which have made Pennsylvania the greatest of our industrial states are to be found abundantly throughout central China. It is needless to mention that coal, iron and oil are the very backbone of our great modern mining and manufacturing industries.

But China is not without many other mineral deposits. It is not my purpose now to go into details, but it may be accepted as a fact that practically everything of a mineral character has been found in some part of that great Empire. Probably, as elsewhere, many, if not most, of these deposits will not be of economic importance—at any rate not for years to come. In timber China is woefully poor. Her forests have been ruthlessly destroyed and not replaced. This, however, is a defect which time and care will rectify, for trees may be planted and forests grow to maturity in a period of time not much beyond the span of the average human life. But time in our human conception can never replace the coal burned and the metals consumed. Hence in a sense, China is younger than the United States, for its mineral resources are practically untouched, whereas we are rapidly depleting both forests and mines. We are, as a nation, something like 4850 years younger than China. These statements may seem fanciful; I admit they are decidedly general, but I fail to see how they may be well disputed. At any rate they afford substantial food for reflection, and it is worth while carrying them in mind.

The Unbalanced Population

There is also another side of this picture. China is over-populated, or at least its population is badly distributed, for until recently it had no railroads by which proper distribution could be accomplished. Moreover, many parts of the northern provinces near Mongolia are arid and can never be expected to support a large population. Irrigation and stream-flow regulation will no doubt do much to overcome this drawback.

Then again, the great plains of China to the south and north of the Shantung promontory are subject to disastrous floods from the Yellow River. This great stream carries out into the China Sea vast quantities of yellow silt from the *loess* or yellow-dust deposits of the northern provinces; and while its waters often bring destruction in one hand their burden of silt carries fertilization in the other, for this *loess* soil contains considerable calcareous and nitrogenous material which enriches the fields upon which it is deposited. It is manifest, therefore, that where this turbulent stream is confined within its banks by artificial means the river bed will rise by reason of the deposition of the silt upon it and the surrounding land will not be fertilized as when it is overflowed and the silt

*It is not generally known that in 1865 Richthofen made an examination of the Comstock lode for the Sutro Tunnel Co. The report was published for private circulation, hence copies are now scarce. Becker draws largely from it and speaks of the work in the highest terms. See "Geology of the Comstock Lode"—G. F. Becker, U. S. Geological Survey, 1882.

†Economic Geology, Vol. III, pp. 5 and 6.

deposited thereon. Evidently the control of the Yellow River will be one of the greatest and most difficult engineering problems in all China. Whether the Chinese themselves are able to cope with anything of the kind either financially or as a matter of engineering is doubtful. Besides the improvements of the Yellow River, there are a number of similar problems of lesser magnitude on smaller streams that will have to be taken in hand. Even now one large American engineering company is engaged in diking the Huai River in Kiangsu Province, and in draining Hangsu Lake, which is in fact part of the low-lying district or delta through which the Yellow River flowed before it changed its mouth in 1852 to where it now empties into the Gulf of Chihli, north of the Shantung Peninsula.

Engineering Opportunities in China

It must not be supposed for one moment that the outside world has been ignorant or indifferent to the great engineering opportunities in China. Since the days of Wharton Barker and Count Miskevitch, who, it is jokingly said, received a concession from Li Hung Chang which virtually gave them all the mineral resources of China, concession hunters have been haunting Peking and securing grants of one kind or another on absolutely scandalous terms by which the natural wealth of the country was practically given away. A few years after the Boxer troubles of 1900 a reaction set in and efforts were made by the Chinese government to get back some of these huge improvident concessions, and in one way or another these efforts appear to have met with considerable success. But there are some concessions, like that to the Peking syndicate, which continue to hold good and are of tremendous value. This particular concession as originally granted to this syndicate included pretty much all the coal in Shansi, which might be compared as approximately equal in value to all the coal, both anthracite and bituminous, in Pennsylvania. This syndicate also received considerable coal areas in Hunan Province and railroad grants of great value.

Realizing the serious mistakes that were made, the Chinese have been using every possible effort to recover what they have so thoughtlessly given away. As a result this reaction, and the very proper but perhaps over-zealous cry of "China for the Chinese," has brought about the enactment of mining laws for the country that are on the whole unwise, restrictive and destined to hamper rather than encourage development. It is evident these enactments have been inspired more by fear than by reason, and as a sensible people we may confidently look to the Chinese for such modifications as will meet any reasonable conditions which foreign capital must demand and receive before undertaking large mining investments in China.

China's future economic importance lies in the development of her coal, iron, cement and oil industries, and with her inexhaustible supply of cheap and good (as compared with India) labor, she is certain some day to be a most tremendous factor in the economic world. This statement in substance has been so often made it is almost trite, but nevertheless it is a prognostication that may not be successfully disputed.

⁂

Elementary Oxygen Imparts a Red Color to an alkaline solution of catechol and ferrous sulphate ("Journ. Soc. Chem. Ind.," Mar. 31, 1915). The reaction may be applied to the quantitative determination of oxygen in gaseous mixtures.

Alaskan Timber Reserve

The President has signed an order establishing a timber reserve, approximately 200 miles in length and from 5 to 10 miles in width, in Alaska to be known as "Alaskan Timber Reserve No. 1."

The reserved timber is upon public lands north of the Chugach National Forest, extending five miles in width along the northern shores of Knik Arm and Cook Inlet between the mouth of the Knik River on the east and the mouth of the Susitna River on the west, thence north five miles on each side of the Susitna River from its mouth on the south to the mouth of the Yentna River on the north. The reserve also embraces the timber on areas five miles in width on each side of the right-of-way of the main line of the proposed railroad through the Susitna Valley to Broad Pass, and similar areas on each side of the right-of-way of the proposed branch line extending into the Matanuska coal fields.

The purpose of the reservation is to prevent the timber needed for the construction of the Government railroad and its branches in Alaska from falling into the possession of individuals or corporations, in which event it would be necessary for the Government to purchase timber which it once owned. It is not the intention of the Government, however, to make any unnecessary restrictions which will tend to retard the development of the Territory of Alaska along the line of the railroad or its branches, and in the withdrawal order the interests of the public have been conserved in every way possible. Only the timber on the land, not the land itself, has been reserved. The land is still subject to location, settlement or entry under the public land laws, and it is provided within the withdrawal order that the Secretary of the Interior may permit settlers in the locality to obtain such timber as they require.

⁂

Russia's Prohibited Exports

By a decree of May 17, all previous prohibitions of and restrictions on the exportation of goods from Russia have been codified. The prohibitions cover the exportations by all frontiers of copper and brass in the form of metal, scrap or manufactures; the exportation by the land frontiers of European Russia and by ports of the Baltic, White and Black Seas, and the Sea of Azov, of coal and coke, pitch, iron ore, manganese ore, naphtha and naphtha waste, benzine, petrol, ligroine, kerosene and other illuminating naphtha oils, spirit, rubber in all forms including manufactures thereof, wire, caps, fuses, saltpeter, nitric and sulphuric acids, and automobiles. The exportation of steel and lead is prohibited by all land and sea frontiers of European Russia.

⁂

Magadi Soda Co.

At the recent meeting of the Magadi Soda Co., Ltd., in London, it was announced that the work at Magadi had practically come to a standstill owing to the war. The railway line and water-works were commandeered by the Government and the employees of the company volunteered and formed a defense force for the colony under the command of the local manager, Major Symonds. The railway line, which extends through from the coast to the lakes, is still under governmental control.

Editorials

American Zinc Smelting Capacity

In the JOURNAL of March 6, 1915, we estimated that the United States had capacity—first-class and second-class—for the production of about 517,000 tons of spelter per annum at the maximum, but pointed out that that figure ought practically to be discounted for several reasons which need not be repeated. A further necessity for discounting that total is the practice, that has developed among several smelters, of redistilling ordinary spelter for the sake of making a high-class intermediate. This not only involves a double use of capacity, but also entails a considerable loss of spelter in the process, reducing the final output of metal by just so much. On the other hand our estimate did not include the dross- and junk-smelting capacity, which without doubt is in excess of 25,000 tons of spelter per annum, reckoning only the commercial concerns, i.e., excluding all which resmelt their own by-products. Some of these concerns have lately been engaged in producing superior grades of spelter. Making all allowances therefore, it is probable that the listed zinc-smelting capacity at the beginning of 1915 was at least equal to the production of 500,000 tons of spelter per annum.

That list enumerated the smelteries of the United States as "active," "operated irregularly," "inactive" and "new." Since that time every plant on the list has been put into operation, while old plants stricken from the list many years ago, some of them idle since about 1901, have been restored to use. Such are one of the old works at Pittsburgh, Kan., and the old plant at Bruce, Kan., while it is now said that the old plant at Nevada, Mo., is to be repaired and put into commission. All of these are small plants and do not add largely to the smelting capacity of the United States. More important are the extensions of going works that are being made. Thus five furnaces are being added at Caney, a large number at Sand Springs, while at Langeloth new furnaces have been put into commission as rapidly as possible. Additions are being made or are contemplated at other works.

We are now coming to the time when new plants are being projected, the construction having been actually begun in one case. George E. Nicholson is building a four-block plant near Tulsa, and a Joplin company is said to be contemplating a new plant at Pittsburgh, Kan.

It is now reported that the new zinc smeltery of the U. S. Steel Corporation at Donora, Penn., will have a capacity for the production of about 40,000 tons of spelter per annum. This implies an ore-smelting capacity of about 100,000 tons, which will make it by far the largest zinc smeltery in the United States. The works are to be erected on a site adjoining one of the large galvanizing plants of the Steel Corporation. The purpose of the Steel Corporation in erecting this plant is to take one more step in its policy of providing its own raw materials.

Apart from the plans of the Steel Corporation, which for reasons of its own are well-founded, it is evident that the willingness of adventurers to take chances in the erection of new works indicates a belief that high prices for spelter and large smelting margins will prevail for a long time. However, we surmise that all records for speed in zinc-smelting construction will be broken in the works that George E. Nicholson is now building in Oklahoma.

It is evident that we are already witnessing the provision of a very considerable increase of smelting capacity with the probability that more will follow. This will of course gradually ameliorate the tenseness in the zinc situation even if nothing else does so.

Zinc Ore and Spelter

The abnormal conditions existing in the zinc industry of late, and at present, have produced extraordinary variations with respect to the value of zinc ore, and a good deal of the controversy respecting the latter is due, no doubt, to misunderstanding of the terms of buying and selling raw material.

Zinc ores are sold in three principal ways—on sliding-scale contracts, on flat contracts, and by bids and offers in the open market.

Sliding-scale contracts are based upon the price for spelter. We have lately witnessed circumstances wherein ore coming in under sliding-scale contracts was paid for on the basis of 25c. for spelter, while the smelters were delivering spelter at 8 to 10c. per lb., which had been sold several months previous. The time will come of course when the opposite condition will prevail—that is, smelters may be taking in ore on the basis of 8 to 10c. for spelter and receiving upward of 20c. upon deliveries that were contracted for during May.

The selling of ore upon a flat price is a very simple matter. For example, a mine operator may in December agree to sell his output for the next six months at so much per ton, and be done with it. In this case fluctuations in the metal markets are of no concern to him, except that he is likely to feel good if it turns out that spelter averages less than what he figured—and inevitably he will feel sore if it turns out the other way.

The third way of selling zinc ore, the way that prevails especially in the Joplin market, is precisely analogous to the selling of any commodity, day by day or week by week, by offering it in a public market. Buyers bid what they think it worth to them, and sellers refuse to accept their bids if they think them too low.

Last spring the price for ore in the open market was excessively low. There were two chief reasons. The supply of ore offered under contracts was bountiful, and smelters, unable to sell spelter ahead with the freedom they desired, were reluctant to take chances on buying too much ore. Later the ability of the smelters to sell their spelter ahead changed radically, which made it

safe for them to buy ore against their contracts, and then the price for ore in the open market rose.

In considering the relations between zinc ore and spelter there are several things that it is needful to bear in mind. Some of these are the following:

A smelter must carry in stock a supply sufficient to run his works from one to three months. Consequently it is to be reckoned that such a time has to elapse before the zinc of incoming ore is rendered marketable as spelter.

The bulk of the blende of the Joplin district and Wisconsin is taken by the smelters who make sulphuric acid, especially the smelters of Illinois, who prefer those kinds and whose competition years ago practically drove the other smelters out of the Joplin market.

Nearly all the ore from the regions west of the Rocky Mountains is marketed according to sliding-scale contracts, and the old system, which still prevails in the Joplin market, is of far less importance than it used to be, the total ore tonnage of Missouri, Kansas and Oklahoma in 1914 being only about one-third of the total receipts of the smelters; but on account of its superior grade this ore probably accounted for nearly three-eighths of the production of spelter in that year.

The Rise and Fall of Lead

The consensus of opinion is that the recent rise in lead, or the spectacular part of it at least, was engineered in Wall Street. The evidence on this point is considerable. The early stages of the rise from the level of 4.20c. were economically well founded. A shrewd, powerful and well-informed group of speculators then perceived and seized the opportunity to conduct a movement. The buying on the way up was not confined to them, however. Consumers and ammunition manufacturers were overcome by a panicky feeling, having the previous events in spelter fresh in mind, and entered into some very large contracts for deliveries far ahead at high prices. This business was done chiefly around 6c. Of course the bulk of the lead consumers were unaffected, their supplies being provided for by long-time contracts with settlements on quotations. Although they might have to pay more for their June lead, they were not in any doubt about getting it. A very large proportion of the lead business is done in this way. The quantity of free lead being correspondingly small, the recent speculative operations were the more easily conducted.

During the excitement the leading interest—the American Smelting & Refining Co.—preserved its poise admirably, maintaining its price of 7c. even while outside lead was realizing 8c. On the other hand it inflamed the situation by refusing to deviate from its policy of selling only for shipment within 30 days and moreover declining to do business with all comers, giving the preference to its regular customers. These procedures were unexceptionable; but they naturally excited crazy buyers, who tried and failed to obtain lead in the principal quarter, and forced them to sellers who had been standing aloof, waiting for just such an event.

The collapse came when speculators undertook to realize and found that they had been played with. Just as they had bid up the market against themselves, they depressed it. The A. S. & R. Co. completely lost control of the market on the way up and equally so on the way down. In the end the only course for it and other producers was to withdraw and wait for liquidation to exhaust itself, for no matter how low their price might be put the traders would go ½c. lower so long as they had any lead remaining to be sold.

Wet Concentration, Flotation and Leaching Recoveries

The average copper recovery of the five large wet concentrating mills of the porphyry coppers now in operation in this country is 68.03%. The average recovery by use of the flotation process is generally higher than this. At the 50-ton experimental unit of the Cuba Copper Co. an extraction of 85% was made. At the National mill at Mullan, Ida., with a capacity of 500 tons per day, a total extraction of 85% was made, 30% being obtained by the tables and 55% by flotation units. The Butte & Superior mill using flotation is making 88.03% recovery. The Braden, which is now treating between 3000 and 4500 tons per day, makes a recovery of 75% by the flotation process, and it is officially stated that this figure may be considered a very conservative statement of results accomplished. At the Inspiration, in Arizona, the experimental mill which treated 76,000 tons of ore gave an average recovery of 86.7%, and at times as high as 90.3%. It was on the basis of results accomplished in this experimental mill that the Inspiration is now building its 15,000-ton per day flotation plant, one-half of which is nearly ready for operation; the other half it is expected will be in operation by the end of this year.

Based on a large amount of experimental work, a leaching plant said to be of 4000 tons capacity is being designed for the New Cornelia in Arizona. The elaborate tests conducted by Mr. Croasdale demonstrated that a recovery of between 80% and 85% was obtainable, depending upon the fineness of crushing and the length of time of leaching.

These figures are not given as a comparison to indicate that a superior process has at last arrived to totally displace "the honorable" wet concentration, but only to answer a question about relative results which frequently arises. The fields for application of these processes overlap to a certain extent but the processes are not interchangeable and none is universally applicable.

Why Chemical Dealers Don't Answer Inquiries

We are constantly receiving complaints that letters of inquiry to various manufacturers of alloys and chemicals do not bring any replies. This is perhaps explained by the statement of a prominent official of one of these companies that at the outbreak of the war they were simply swamped with inquiries regarding rare chemicals and rare alloys. After spending a great deal of time replying to these letters, they looked up a few of the inquiries and became convinced that they were simply dictated by German agents who wished to find out what this company was going to do in the matter of supplying various materials which usually came in from Germany. Since that time, he said, they had answered only letters from persons who were known to them or who gave them unimpeachable references.

BY THE WAY

A U. S. Geological Survey Bulletin gives a list of well-known rivers and the amount of organic matter contained. The Nile has 10.36%; the Hudson 11.42%; the Delaware 16%; the Uruguay 59.9% organic matter—we have eaten many vegetable soups that didn't come up to the latter.

⁂

A shoveler in one of the Joplin zinc mines who had seen in the movies how the gold miners bought what they needed with gold nuggets, last week laid a small chunk of zinc ore on a bar counter and called for a beer. The bartender served the drink to him and laid down 20c. in change and, of course, the crowd laughed and cheered. Such, says the *Wall Street Journal,* is the spirit of the Joplin zinc boom, with crude zinc ore now worth 7c. a pound which is about 50% higher than the refined product spelter has averaged for many years.

⁂

Louis H. R. von Ruecau, a mining engineer, who operates the Cuale mine in the State of Jalisco, Mexico, when not dodging or stopping bullets or visiting in the United States, tells of an amusing experience which threatened to put a permanent end to his activities. While visiting a Mexican friend in the city of Tlaxcala a local home-made 7-mm. revolution broke out. Louis heard that something had started; but although he has occasionally been a target for frivolous Mexicans, he did not attach very much importance to the rumor and enjoyed his customary strolls about the town. One evening while pausing to light a cigar he felt a cold circle of steel pressed against the back of his neck. Casually glancing over his shoulder, he gently inquired what might be the trouble. The sandaled patriot behind the gun gruffly hiccoughed: "I am going to kill you, because you are a —— —— foreigner." "That is foolish and unnecessary," replied the prospective victim. "But that is a beautiful rifle you have. Is it not a new one?" "Ah, si, Señor, I just received it today. Here, take it and examine it and tell me if you do not think it is a very fine rifle." Von Ruecau took the rifle, looked it over carefully and handed it back, offering a fine cigar with the other hand. The peon accepted his rifle and the gift; then he took off his hat and bowed politely, saying: "Many thanks, sir; I wish you good-night."

⁂

Because the question of a general amalgamation of Rand gold mines has been so frequently discussed in recent months, this subject was touched upon by Chairman Lionel Phillips at the recent annual meeting in London of the Central Mining & Investment Corporation, which has extensive interests in this field. He said: "A good deal of discussion has taken place in recent times upon the subject of a general amalgamation of the gold mines. Looked at purely as an economic proposition, I have no hesitation in saying that considerable economies could be effected if the control of the mines were vested in a single body of capable men, and the interests of all shareholders were rendered identical instead of continuing the present system of various and, in some cases, competing interests. I must not go fully into so complex a subject today, but I venture to say that, under existing conditions, general amalgamation is neither desirable nor practicable. In the first place, we know by our more limited experience of uniting mines that it takes a considerable time and expenditure of capital before full benefits can be manifested. In the second place we know that, although an amalgamation of mines might contribute to the ultimate welfare of the South African Government and people, it would involve considerable hardship to the Witwatersrand community in the first instance, and the political effect of such a step cannot be disregarded. I am therefore of opinion that we should at present, anyhow, dismiss from our minds so ambitious a scheme as that of general amalgamation."

⁂

Ross-Burrage Hearing to be Sept. 13

The suit of Louis Ross against Albert C. Burrage, vice-president of the Chile Copper Co., to recover 10% of the profits secured by Burrage in the flotation of that company, has by consent of both sides been put down for final hearing on Sept. 13, according to the *Boston News Bureau.* Ross claims to have been the original discoverer and to have secured options for Burrage, working on salary and commission under written agreement. These options were transferred by Burrage to the Chile Exploration Co., all of the stock of which rests in the treasury of the Chile Copper Co.

⁂

Changes in British Prohibited Exports

An Order in Council has been issued making a number of amendments in and additions to the British list of prohibited exports. The following are the alterations in the section covering the iron, steel and allied industries, says the *Iron and Coal Trade Review:*

That the heading, "Zinc and iron ore (including zinc ashes, spelter, spelter dross, and zinc sheets)," in the list of goods the exportation of which is prohibited to all destinations abroad other than British possessions and protectorates, should be deleted, and there be substituted therefor the heading, "Zinc (including zinc ashes, spelter, spelter dross, and zinc sheets)," in the list of goods the exportation of which is prohibited to all destinations, and the heading, "Zinc ore," in the list of goods the exportation of which is prohibited to all destinations abroad other than British possessions and protectorates.

That the following articles should be added to the list of goods the exportation of which is prohibited to all destinations abroad other than British possessions and protectorates:

Chemicals, drugs, medicinal and pharmaceutical preparations: Hydrochloric acid; oxides and salts of nickel; oxides and salts of tungsten.

Metals and ores, the following, namely: Wolframite; minerals and vegetable wax; tungsten filaments for electric lamps.

That the following articles should be added to the list of goods the exportation of which is prohibited to all foreign ports in Europe and on the Mediterranean and Black Seas, other than those of France, Russia (except Baltic ports), Spain and Portugal:

Chemicals, drugs, etc.; arsenic and its compounds.

PERSONALS

H. A. Morrison is investigating a placer proposition near Weaverville, California.

H. J. Wolf, of Denver, examined mining property in Gilpin County, Colorado, recently.

Benj. H. Case has returned to Asheville, N. C., after several months' professional work at Mineral, Virginia.

Alexander Stanley Elmore, who has been visiting in this country for several months, returned to London on June 26.

George H. Garrey was in New York for a few days last week and has now gone to San Bernadino County, California.

R. D. Fetherstonhaugh, of Vancouver, B. C., and party have gone to investigate mining prospects on the Peace River and at Fond du Lac.

J. Norman Bulkley, of New York, has been appointed consulting mechanical and electrical engineer to the Canadian Mining & Finance Co., Ltd., of Montreal.

Arthur J. Hoskin, of Denver, has been for the past two weeks in the Tincup district, Colo., for the Tincup Gold Dredging Co., drilling and examining placer ground.

Thomas H. Kenvin recently with the Indiana Steel Co. at Gary, Ind., left last week for India to take a position as superintendent of the steel department of the Tata Iron & Steel Co. at Sakchi, Bengal.

Silvio DeVescovi lately engineer with the Societe Francaise des Mines de Cuivre Collahuasi-La Grande, in Collahuasi, Antofagasta, Chile, is now enrolled in the Italian army and has gone to the front.

L. D. Cooper of the engineering staff of the E. J. Longyear Co., Minneapolis, Minn., sailed last week with a crew of 60 miners for Norway, to sink a shaft for the Orkla Mining Co. at Lökken, near Trondhjem.

Robert L. Sackett, late of Purdue University, has been appointed Dean of the Engineering School of Pennsylvania State College. He succeeds John Price Jackson, who is now labor commissioner of Pennsylvania.

W. C. Tharp, recently with the Metallurgical Testing Labcratory of Pittsburgh, has been appointed manager in Pittsburgh for the Hoskins Manufacturing Co., of Detroit, makers of electric furnaces and pyrometers.

David A. Thomas, for many years a well known coal mine owner and operator in Wales, has been appointed purchasing agent for Great Britain in the United States and Canada and will have offices in Ottawa and New York.

The well known firm of D. R. Hanna & Co., Cleveland, Ohio, prominent shippers and miners of iron ore and coal has been reorganized. D. R. Hanna has retired, L. C. Hanna and H. M. Hanna, Sr., have associated themselves with the remaining partners, R. L. Ireland, M. Andrews and H. M. Hanna, Jr. L. C. Hanna was formerly head of the firm, retired some years ago and now returns.

Dr. Arthur A. Noyes, of the Massachusetts Institute of Technology, is to become a member of the faculty of the Throop College of Technology, Pasadena, Calif., for a portion of the coming academic year, and for one-half of the time in succeeding years, beginning with 1916-17, this arrangement having been made possible by a gift of $10,000 for the equipment of a physical chemistry laboratory, and the endowment of this laboratory in a sum yielding $10,000 annually for its support.

OBITUARY

Frank S. Castello, President of the Mary McKinney Mining Co., Colorado Springs, died June 18 at Los Angeles, Calif., where he had gone for his health. He was interested in several other companies in the Cripple Creek district.

Among those reported killed in the Mexican troubles are Stephen A. Parmenter, an engineer who is reported to have been killed at El Favor mine in Jalisco, June 22, and Robert Camp, formerly of Denver, who was reported by telegraph killed at Monterey.

A dispatch from Washington, June 19, says: "Gilbert Teanhl, of Oklahoma City, superintendent of an iron mine, was killed while interfering in a private quarrel near Charcas, Mexico, on Wednesday. A dispatch to the State Department from Consul Bonney, at San Luis Potosi, today announced three arrests had been made.

John A. Finch, for many years a prominent mining man in the northwest and one of the pioneers of the Cœur d' Alene, died suddenly at Hayden Lake, Idaho, June 20. He was 61 years old and had been engaged in mining in Idaho, Montana and Washington for the greater part of his active life.

Henry C. Bolsinger died in Denver, June 21, after a long illness. He was 59 years old and for over 40 years had been engaged in mining in Colorado, having been at Leadville and Cripple Creek as well as at Central City, which was his home and headquarters for a number of years. He represented Gilpin County in the Colorado legislature for several years. He was also in Mexico for a time. He had a remarkable memory and a wide knowledge of mining property and was credited by his friends with knowing the history of practically every mine in Colorado for the past 40 years.

Scott Eldridge, mining engineer of Kerr Lake mine, Cobalt, Ont., and W. B. Foote, a capitalist of Geneva, N. Y., were instantly killed on June 25th by a blast at the mine. Mr. Foote who was about 45 years of age, had been in Cobalt for two or three days looking after his investments. He was being shown the Kerr Lake mine by the engineer, and they were in the stope at the 140-ft. level when the blast went off at the regular time at the 250-ft. level, and coming up the stopes killed both of them. Mr. Eldridge was about 25 years of age and leaves relatives in Philadelphia.

Thomas D. West died in Cleveland, Ohio, June 18 from injuries received by being struck by an automobile. He was 64 years old. He was born in England, but came to this country when a boy and when 12 years old, began work at the foundry of the Portland Locomotive Co., Portland, Maine. After mastering the foundry business, he organized a company at Sharpsville, Penn., which is now known as the Valley Mold and Ingot Co., makers of ingot molds. In 1907, he organized the West Steel Casting Co., at Cleveland, Ohio, of which he had since been head. Mr. West devoted much time and labor to the elevation of the foundry business and to the writing of text books on foundry practice and the metallurgy of cast iron. He was much interested in the American Foundrymens' Association, of which he was always an active member and of which he was president for several years. He established the use of standardized drillings for the checking of pig iron analyses as well as many other improvements. In the recent years, he was very much interested in the movement for the prevention of accidents and for greater safety in industrial employments. He was a member of the American Society of Mechanical Engineers, the American Society for Testing Materials and several other mechanical and scientific societies. He leaves a widow, a daughter and two sons.

Charles L. Gilpin, who for many years was one of the most widely known men in the sheet trade, died at a hospital near Philadelphia, June 7, aged 88 years. He was born at Wilmington, Del., and after receiving his education in that city moved to St. Louis in 1845, where he engaged in the iron and steel business. During the Civil War he was connected with the quartermaster's department of the army. After the war he was for many years associated with Alan Wood & Co., now the Alan Wood Iron & Steel Co., Philadelphia, and subsequently with W. D. Wood & Co., Ltd., Pittsburgh, and the successor, the W. Dewees Wood Co. He was a relative of W. Dewees Wood, who sent Mr. Gilpin to Russia to investigate the manufacture of Russia sheet iron, and to ascertain how to reproduce in this country the beautifully planished surface of the sheets which were then celebrated throughout the world for their rust-resisting quality. He was successful in his investigation, his genial personality contributing largely to this result, and the process thus brought to this country established the reputation of the firm whose plant was finally merged with other properties into the American Sheet Steel Co., afterward becoming part of the United States Steel Corporation. He was exceptionally well informed on the steel business, especially the sheet branch, and was an authority on tariff legislation. He leaves his widow, one son and two daughters.

INDUSTRIAL NEWS

K. E. Kersten has been appointed branch manager of the Boston Belting Co., 172 West Randolph St., Chicago, Ill.

The Terry Steam Turbine Co. announces the appointment of Joseph Battles as District Sales Manager for Denver, covering the states of New Mexico, Colorado, Wyoming and the western part of Nebraska. His address is 326 First National Bank Bldg., Denver, Colo.

Editorial Correspondence

SAN FRANCISCO—June 23

Corporation Tax in California for 1915 amounts to $15,036,798, as against $13,609,633 in 1914. The largest corporation tax payers are the railroads, which will pay an aggregate of $6,588,284; oil wells will pay $410,034; power companies $122,761, and mines $69,870.

Gold-Dredge Construction for the last year or so has not been so active as in recent former years and there has been a good deal of talk about the gold-dredging fields being exhausted. There have been a number of things combining to retard advancement of gold dredging for the last two years. The present aspect of the industry is much brighter and contracts are being let for dredge construction to be completed within the next two years that will total approximately $750,000. As to the exhaustion of dredging fields there is no solid basis for such reports. It has been the policy of all large mining investors who have their money placed profitably to play a waiting game with the owners of mining ground, whether placer or quartz. In various instances large areas have been examined by dredging companies and turned down for different reasons, that prospecting did not prove high values, or the price was too high, or the terms not satisfactory. So long as dredges can be operated in rich gravel deposits there is not much hope of low-grade properties being successfully exploited. But the rich placer grounds are being exhausted and dredge operators must content themselves with lower yield per cubic yard. The demand for gold is sufficient incentive to attract investors to ground that will pay a fair margin on the investment in dredge construction. The recent contracts for new dredges and contemplated construction include the Yuba Consolidated Gold Fields at Hammonton and the Marysville Gold Dredging Co. at Marigold, the Natomas Consolidated at Natoma, in California, and the Powder River Gold Dredging Co. near Baker City, Oregon. Yuba Consolidated contemplates the construction of an all-steel dredge to be known as Yuba No. 15. It will be of the same design as Yuba No. 14, which was put in commission in December, 1914. No. 14 is at present the largest all-steel gold dredge in the world and is equipped with 16-cu.ft. buckets. No. 15 will be a larger boat and will probably be an improvement in some respects upon the other dredge. This dredge will be built by the Yuba Construction Co. at Marysville. The Marigold dredge will be built by the Union Iron Works and will be similar to Yuba No. 14 and equipped with 16-cu.ft. buckets. Guggenheim interests on Yuba River, north of the Yuba Consolidated, also contemplate construction of one or more dredges; though their plans have not yet been made public. This land has formerly been turned down by other investors, but it is safe to say that there is a possible profit in sight or the Guggenheims would never have taken over the land. Natoma No. 4 dredge which operates in the Natomas field on American River will be rebuilt after a new design which will provide for the placing of the tailing so that the gravel will be evenly distributed for the soil on top. In other words the dredged land will be reclaimed for agricultural purposes. There is a large area of agricultural ground within the dredging field at Natoma and there has been in the past a great hue and cry about the destruction of valuable agricultural land by the gold dredges. While it might have been possible in the beginning to reclaim all these lands as the dredging was being done, the financial results might not have enabled the Natomas, or any other operators, to operate at a profit sufficient to guarantee large investment. The Powder River Gold Dredging Co. in Oregon has now in course of construction a 7½-cu.ft. bucket-elevator dredge of the California type, designed and built by the Yuba Construction Co. This dredge will dig 30 ft. below the water line, which is sufficient depth for its ground. This will not be an all-steel dredge, but will have a wooden hull which will be entirely fireproof. The experience of the Yuba Construction Co. in dredge construction will guarantee notable advancement in the construction of wooden hulls. It is reported that another dredge is contemplated in the Baker City region by the owners of the I. L. Borden bridge (formerly the Isabella) at Jenny Lind, Calif. Placer ground is being examined in Shasta and Trinity Counties with fair prospects of dredges being installed and it is not unlikely that before the end of the present year the installation of new dredges will be undertaken, not only in these counties but in other parts of California. It is not likely that there will be demand for more of the large all-steel dredges, but there is opportunity for installation of the smaller size dredges, and there is no good reason why such new construction should not be entirely of steel and patterned after the smaller boats recently completed for the Yuba Consolidated by the Yuba Construction Co. Gold dredging in California is by no means on its last legs.

BUTTE—June 24

Butte Now Has Three Miners' Unions, but they are not very formidable and are not likely to become so. When the old Butte Miners Union surrendered its Western Federation charter and seal it revived itself as the Butte Miners' Union, a corporation, and solicited members among the miners who are opposed to Moyer and his federation crowd. The union has been going it alone nearly two weeks and has succeeded in getting a membership of about 40. Moyer's federation agents have been working to get members back into the fold for six weeks or more and are now operating under the name and charter which the old union surrendered, but in six weeks they have obtained only about 200 members, and that seems to be about the limit of the federation sympathizers. Then there is the original rebel organization of I. W. W.'s, the Butte Mine Workers' union, which still maintains an organization through a few officers, but has no members. There are more than 12,000 miners working in the Butte district again, and the results of the efforts to organize unions indicate that the men who work with their hands are satisfied to stay on the outside and that they have no particular sympathy with the men who work with their jaws only. The miners are getting their $4 a day, and they have neither union nor contract to enforce the payment, but they find that the employing companies are a pretty decent lot of corporations and will do right if permitted to do it.

DENVER—June 25

Golden Cycle Mining & Reduction Co. will hereafter declare dividends of 2c. per share on the 10th of each month with strong probability of occasional special dividends to "take up the slack."

Midland Oil and Gas Company has been incorporated for $100,000, by Denver men to explore, by drilling, 160-acre tract a few miles northeast of the city. Another company, the Mid-Colorado, has drilled down 1800 ft. on another property in same locality and is still drilling. For years, geologists have believed that oil and gas exist in these measures although probably at considerable depth.

Purchase of Stratton's Independence Mine, Victor, by the Portland Gold Mining Co. has increased the latter's area by 250 acres. As viewed by a man on the outside, one strong feature in this consolidation is the opportunity afforded to now handle, by gravity, the tremendous dumps about the lower Portland shaft into the Independence mill for cyanidation. While the Portland has a magnificent mill, it is on top of Battle mountain convenient to the dumps at the upper shaft. Material from the lower dumps can be delivered to this mill only at considerable expense for transportation. The Portland mine proper is in splendid condition for ore production. Officials are reticent about plans.

SEATTLE—June 22

The Most Important Mining Deal completed in Fairbanks in the last several months was consumated by the payment of $20,000 for the Midway Association group of claims owned by E. A. Suter, P. C. Charles and L. B. Clough, by Jack Leach to be operated on a lease. Mr. Leach will start work July 1. The property has never been considered very highly and has been held by the present owners for more than 10 years, with little development work, but recently the Sjolseth brothers operating on the upper portion of the claim struck pay that will run approximately $2 to the foot. The gold is coarse and is pronounced by miners to be "paystreak" gold.

Operators Are Jubilant here over the bonding of the Hermann-Eaton property to the Alaska-Gastineau Mining Co., of Juneau, and feel that it marks the advent of other big operators into the district. The property was located three years ago about 1½ miles from tidewater at the head of Beetles Bay, Port Wells. It consists of four claims, lying

at an elevation of 700 ft. The vein is exposed for 300 ft. and is a high-grade contact vein carrying free gold, lead and iron sulphides, and silver. There is an incline shaft 112 ft. in the ore. The new owners will sink to the 200-ft. level at once. By running a tunnel 650 ft. long and building a dam 10 ft. high and 30 ft. long, sufficient power to operate a 150-hp. Pelton wheel will be developed.

Ruby is Better Than Expectations according to the latest cleanups from that creek which show that early work has netted considerably more so far this year than before, and it is expected that this creek will more than double its 1914 output. Selch, Deitz & Walker during the winter expected the cleanup of their dump would net about $80,000 and with only half the dump sluiced the returns are better than $90,000. Alex Larson has found dirt on Long Creek that runs $7 to the foot. This ground is now being worked extensively. Ruby Creek did not suffer, as most of the creeks this spring, on account of the thaws and was remarkably free from overabundance of water which retarded work on so many creeks. This trouble is now over and all the creeks of the district are working overtime to make up for what was lost. This is true of the Hot Springs district which showed so well last year. At Tofty, Cleveland & Howell have the largest plant that is now in operation and the output for the year will be greater than last. Bock has commenced operations on Woodchopper Creek. Joe Eglar is working a large plant with several others and expects to take out a large yield this summer. Good cleanups have been made on Cleary Creek. John Parquette, in making a cleanup of No. 4 Below Cleary, found that his dump, which was taken out with a windlass in a month, contained $1957. He was prevented from doing work most of the winter on account of water. The same trouble was encountered by other operators on this ground, most of them are taking in or will take in shortly, boilers and mining outfits to cope with the situation.

FAIRBANKS, ALASKA—May 29

Fairbanks Production—The First National Bank of this city has prepared an estimate of the output of this region for the coming season. It looks for a total placer production of $3,150,000 with Cleary and Sullivan creeks as the largest producers. In addition, it estimates an output of $650,000 from hard-rock mines.

Antimony—E. L. Scafford, of Chatham creek has 200 tons of antimony ore on the dock, ready for shipment on the first boat via St. Michael. This ore will go about 60% antimony. The continued rise in the price of this metal has revived interest in the hard-rock prospects of the Kantishna country. Outcrops of antimony seem to be widely distributed in that region, which is about 100 miles west of here. Transportation to and from that district is very difficult as yet.

HIBBING, MINN.—June 26

The Largest Shipper on the Mesabi Range as usual is the Oliver Co. Ore is going forward at a rapid rate from all of the company's mines on the range, as well as on the other ranges. The independents are working most of their pit mines, but few of the independent underground mines are mining ore. The M. A. Hanna Co. is not turning a wheel on the entire Mesabi range. Many of the smaller operators maintain that they cannot make money by operating their underground mines at present.

DULUTH—June 25

Refusal to Pay Taxes by the Mining Companies owning property in the Village of Hibbing, on the Mesabi range, will place their case before the courts. The assessed value of the village is $84,000,000, and as the companies possess 96 per cent. of the property, the community will derive little money from the remainder of the taxpayers with which to pay running expenses. The companies have decided that the school districts shall not suffer from a lack of funds and have agreed to finance them if necessary. The action was taken on the part of the mine owners because of the extravagant use of money by the village authorities during recent years, mentioned in these columns Apr. 3. By refusing to pay their taxes the companies are placing themselves subject to a charge of 10% additional, which they are willing to risk to bring about a readjustment of existing conditions. At the last session of the Minnesota state legislature an effort was made to pass a bill limiting the per capita tax of towns and villages of the state to $25, but the bill failed in the house after passing in the senate by a large majority. The companies that have refused to pay are the Oliver Iron Mining Co., Mahoning Ore Co., Shenango Furnace Co., Jones & Laughlin Co., Inter-State Iron Co.; Pickands, Mather & Co., Republic Iron & Steel Co., Rogers-Brown Co., Great Northern Ore Co., Sargent Land Co., and Northwestern Improvement Co.

LORDSBURG, N. M.—June 24

Sodium-Nitrate Deposits in Grant County are coming into prominence and are attracting the attention of those interested in the products of the mineral. The deposits were first discovered in 1913 and little attention was paid to them until the fall of 1914 when active prospecting began and large areas of mineral bearing ground were located. The nitrates are found on the western slope of the Peloncillo Mountains on the eastern side of the San Simon Valley near the town of Rodeo, N. M. The outcroppings can be traced for a distance of nearly 50 miles north and south with a width of from one to four miles. At Rodeo the outcroppings form the yellow cliffs fringing the eastern side of the San Simon Valley. Until recently little work, aside from the necessary location requirements had been done. On one of the best claims the deposits lie at an angle of about 45 deg. with a footwall of porphyry and a hanging wall of quartzite. At one place the body shows a thickness of over 100 ft. The nitrates are disseminated through the rock and where cavities occur in the formation, collect into nodules of nearly pure sodium nitrate. The deposits are favorably situated as regards railroad transportation, being a short distance from the El Paso & Southwestern tracks. Water is plentiful and all conditions are indicative of economical operation. The U. S. Geological Survey has not yet examined the Rodeo deposits of sodium nitrates but has expressed its interest. Thus far no potash or nitrate withdrawals have been made either in New Mexico or Arizona. The deposits are coming into prominence and are being examined by engineers from various parts of the United States.

WILLCOX, ARIZ.—June 25

The Mascot & Western R.R., which connects the mines of the Mascot Copper Co. with the Southern Pacific at Willcox, Ariz., was completed June 15 and a celebration in honor of the occasion was attended by about 4000 people, many of whom were shareholders of the Mascot Copper Co. The construction of this road was commenced the latter part of January, this year. Shareholders from the East and West came in special trains and upon arrival at Willcox were met by the mayor of the town and a delegation of business men, who with the Willcox band gave the incoming visitors a royal welcome and sent them over the last lap of their journey on the Mascot & Western to Mascot. Upon arrival there they were met by T. N. McCauley, president of the Mascot Copper Co., and the Sixth Field Artillery Band. Following speeches by Mr. McCauley, H. A. Morgan the mayor of Willcox, James G. McNary, vice-president of the First National Bank of El Paso, Mayor Frank K. Mott of Oakland, Calif., Hon. John A. Street chief counsel for the company and Judge John M. Raymond, of Aurora, Ill., the crowds were directed to the railroad tracks near the depot where President McCauley drove the last spike which officially completed the railroad. A large barbecue was then served, for which about a dozen fat beeves had been prepared.

The Building of This Railroad means much to the Dos Cabezas mining district where rich mineral ground has been known to exist for years. While the railroad has been built exclusively by the Mascot Copper Co. for the transportation of its ores to the smelters, it will have as a feeder the entire Dos Cabezas district. Already considerable activity has been apparent in the district other than that of the Mascot company since the new road was started. Transportation is all that has been lacking to make this district occupy a prominent place among the mining camps of northern Cochise County, Arizona. Several years ago the Mascot company commenced the development of its claims embracing about 800 acres of highly mineralized ground in the heart of the Dos Cabezas district. The main development has been carried on through a tunnel known as the Consolidated tunnel on the western portion of the property. By means of this tunnel the ore has been developed and blocked out for a depth of about 700 ft. below the surface croppings. The tonnage is estimated to be about 1,000,000 tons of merchantable ore. The railroad, just completed, cost $300,000. Its length is 15 miles and although the last four miles traverse a mountainous country, the steepest grade is not more than 3%. At the same time the construction of the railroad was commenced an aërial tramway, 10,000 ft. in length, with a capacity of 1000 tons per day, reaching from the mines to the unloading bins at the new town of Mascot, was also begun. This was rushed to completion simultaneously with the railroad and cost about $20,000 per mile. At the close of the ceremonies June 15, the first train of ore left the camp for the smeltery at Douglas.

NEW YORK CITY—June 30

Miami Copper Co. has increased its dividend to 75c. per share, payable Aug. 15. This increase was entirely unexpected.

The Mining News

ALASKA

GRANBY (Valdez)—Outside construction to be finished in about a month, when Midas mine will start operating.

ALASKA INDUSTRIAL (Ketchikan)—Aërial tram being repaired. Expect to start shipping copper at once. Charles E. Sulzer is manager.

ALASKA FREE GOLD (Willow Creek, Knik)—W. E. Martin plans installation of compressor and drills when power project on Little Susitna River goes through. If this project planned by Seattle people is abandoned, he will install his own power plant.

McKEEVER BROS. (Juneau)—On Nelson-Lott claims, Sheep Creek Basin, 2500-ft. tunnel to orebody has been started. Arthur Riendeau, who drove Jualin tunnel last summer, has contract for tunnel. Water hammer drills are being used. $250,000 work planned to develop property.

ALASKA GOLD (Juneau)—Thomas Kneebone, who suffered a broken back in Perseverance mine some time ago, brought suit against Alaska Gastineau company for $75,000 damages. Suit thrown out of court by Judge Robert Jennings on June 18. Insufficient evidence as to company's liability.

GRANITE GOLD (Valdez)—Lower adit tunnel is in 600 ft. of 800 ft. planned. Will start raising from adit tunnel to workings in about month. New cross compound compressor, 10-stamp mill, and other new equipment installed. Good showing of ore continues. W. R. Millard, Superintendent.

CALIFORNIA

Amador County

CENTRAL EUREKA (Sutter Creek)—Prospecting by winze below 3100 level. Mill running regularly with 30 stamps dropping.

BUNKER HILL (Amador City)—The 2400 level has been retimbered and development from this point will proceed. In May mill crushed 6700 tons of ore, and produced 200 tons of concentrates, which averaged $80 a ton.

Butte County

SOUTH BANNER (Oroville)—Extensive improvements on Amosky mine are being made. New machinery to cost about $3000 is being installed.

Calaveras County

EAGLE MARBLE QUARRY (Vallecito)—Reported that production will begin at an early date. There is large deposit of marble which it is said can be quarried and shipped at profit.

COLUMBIA (Angels Camp)—Property bonded to E. J. Carter and J. S. Rear. Electric hoist and compressors are being installed. Chile mill will be added to reduction plant. Other improvements are contemplated and it is expected to increase milling capacity to 500 tons per day. Property situated between the Utica and Maloneys.

Eldorado County

RISING HOPE (Placerville)—George W. Englehardt is reopening this mine and installing necessary machinery.

UNION EXTENSION (Dixon)—J. Hillhouse and Roy D. Mayes have taken contract to develop mine and furnish machinery.

UNION MINE EXTENSION (Placerville)—Petition filed with State Corporation department asking permission to sell 127,500 shares of capital stock. Mine is located at Mud Springs.

FROG POND (Garden Valley)—This property and Collins & Bacchi quartz mines will be reopened and extensively developed by Philadelphia men, owners of Collins & Bacchi, who have recently acquired Frog Pond. J. C. Levitt is superintendent. Properties are developed by shafts to depth of 130 ft. which will be deepened.

Inyo County

CERRO GORDO (Keeler)—Bucket tramway extending from mine to railroad station at Keeler, 29,110 ft., is expected to be ready for service early in July. Tramway will have a capacity of 1500 tons per hour and will effect saving of $2.50 per ton on all ore shipped. Large shipments of high-grade zinc ore are going to smeltery. There is large reserve of silver-lead ore.

Kern County

WERINGER (Woody)—Joseph Weringer, manager, contemplates installation of leaching plant.

ANTIMONY is reported discovered in ledge near Caliente in Old Horse Cañon. Samples assayed by Ward M. Mills of High School laboratory showed 96% antimony sulphide and trace of silver.

NEW CREEDE is name of camp recently established in Lone Pine district, 14 miles northeast of Mojave. High-grade gold and silver ore has been disclosed in development work in progress by Williams and Gragoman on No. 5 claim. George Henry of Colorado and Fred and George Ramey and W. H. Bremendorfer of Caliente are engaged in active prospecting and development. Region is being prospected and claims located over area of six miles square.

Los Angeles County

JORDAN OIL (Vernon)—Series of explosions of gasoline wrecked one of four tanks of plant. Spark from a broken electric wire caused explosion and fire which destroyed 250,000 gal. of oil and gasoline. Driver on an autotruck and firemen were severely burned but no lives were lost. The loss is estimated at $100,000.

Madera County

ENTERPRISE (Madera)—More than 200 tons of ore have been extracted and the mill will start within short time. S. R. Johnson is manager.

Nevada County

EXCELSIOR CONSOLIDATED (Truckee)—Preparations being made to reopen mine, which was closed down at time of outbreak of war.

COLUMBIA (Nevada City)—Arrangements being made for reopening mine in July. Has been closed down since accidental death of W. C. Hunter, mining engineer, and two men recently. Mr. Klinkner is manager.

SHADY CREEK PLACERS (Nevada City)—Small dredge is being installed for working old hydraulic tailing. If found successful other installations will be made to work neighboring ravines which contain hydraulic tailing.

NORTH STAR (Grass Valley)—New 100-ft. steel headframe for Central shaft being constructed. Three large steel bins and sorting plant will be constructed within headframe. New 700-hp. electric hoist will have a capacity for handling 4-ton skips from depth of 6000 ft. incline. Expected to complete the installation by August. Reported that Apex contention between North Star and Empire will be taken into the courts. Expert mining engineers have been employed by both companies for several weeks. Settlement out of court is not now expected.

Plumas County

A GOLD NUGGET weighing 2½ lb. was taken from bedrock of a gravel claim on Squirrel Creek by Byron Turney. Nugget is worth about $540. Squirrel Creek gravel mines have produced probably more large nuggets than any other district in county.

San Bernardino County

ORO BELLE (Hart)—By terms of original contract with Tonopah Belmont, 50-ton mill will be built.

Trinity County

TRINITY ASBESTOS (Castella)—Eight miles of new wagon road from mine have been completed. Total length of road from mine to Castella is 25 miles. Seventy-four men are employed on road and 50 more to be added. Sixteen men are employed at mine. First shipment of asbestos will be made upon completion of road which will be about Oct. 1.

UNION HILL (Douglas City)—Two giants are at work on gravel banks of extreme height of 160 ft. Ditch which carries water from Grass Valley to mine has been repaired. Old Headlight mine at Trinity Center, also owned by this company, may remodel its 40-stamp mill and resume mining. Mine enjoyed long period of activity until oxidized ores were exhausted, and now large reserves of base ore justify installation of fine grinding equipment and filters, so that cyanide treatment may be employed. C. W. Shanks is manager.

COLORADO

Boulder County

WHITE RAVEN (Ward)—F. W. Davis pushing contract to sink main shaft 100 ft. and to start new level. Work will throw light on peculiar structure of this orebody which is unique in this district.

UNITED STATES GOLD CORPORATION (Boulder)—Recent litigation has been disposed of in Supreme Court and company now contemplates considerable additional development. Recent work on 400 level of Nyanza vein has opened high-grade ore.

BOULDER TUNGSTEN PRODUCTION CO. (Boulder)—This company is being financed by Chicago capital and anticipates funds allowing it to drive drainage tunnel through claims three miles from Nederland which will both drain and develop. At present there is no active work being done.

WOLF TONGUE MINING (Nederland)—This company is in market for purchase of tungsten in crude form or for tungsten concentrates of from 10% to 50%, for shipment from mines to either Nederland mill or the Primos Chemical Co. plant near Washington, D. C. Development has not been sufficient to provide enough crude ore for Nederland mill which has been running an average of one week in four, hence their wish to purchase outside ore and concentrates.

NEWHOUSE TUNNEL (Idaho Springs)—Engineer's Leasing Co. has opened an 18-in. vein of pay ore at a depth of 2300 ft. below surface. Selected streaks assay up to 8 oz. gold per ton. On 1300 level of Old Town mine leasers have opened streak of high-grade ore assaying 18 oz. gold per ton. Kuykendall & Co., of Denver, leasing on Bellman vein, have opened pocket of ore below tunnel level which assays as high as 7 oz. gold and 60 oz. silver. Argo mill is running full capacity and treating about 100 tons of ore per day.

Gunnison County

YUKON (Parlin)—New air compressor, boiler and hoist being installed at Yukon shaft, old machinery being transferred to Alaska shaft. Ore carries 36% zinc.

Lake County

WESTERN ZINC OXIDE CO. (Leadville)—Smeltery obliged to close down few days during removal of zinc oxide from large flue conducting fumes from furnaces to bag-house. Twelve tons of material was recovered. Crushing facilities have been found inadequate and much of ore is now crushed at Arkansas Valley smeltery before its delivery.

San Juan County

HAMLET (Howardsville)—Mill will start soon treating mine's complex zinc-copper ore carrying gold and silver.

SILVERTON BUSINESS MEN are organizing $50,000 stock company for local subscription; funds so raised to be used in erection and operation of custom cyanide plant.

Teller County

PORTLAND (Victor)—Was given possession, June 29, of Stratton's Independence property in accordance with terms of sale ratified by stockholders May 18.

ROOSEVELT TUNNEL (Cripple Creek)—Breast is even with Elkton mine shaft. New water courses have been struck and total flow from portal exceeds 12,000 gal. per min. Face will soon be within crater.

MICHIGAN

Iron

MARY CHARLOTTE (Negaunee)—One hundred miners were added to working force here on June 28. There is plenty of ore in stock but large sales have been made recently. Total working force is now 175 hands.

OLIVER (Iron Mountain)—Chapin and Aragon mines were placed on full time June 21. Had been working only four days a week for 10 months. Considerable ore being shipped from both mines.

NEWPORT (Ironwood)—M. A. Hanna Co. has succeeded in disposing of 1,000,000 tons of ore for Newport Mining Co. Will be shipped from Newport at Ironwood and Palms-Anvil at Bessemer. Rapid progress being made at new Newport 14x24 shaft. Last month it was sunk 205 ft.

CLEVELAND-CLIFFS (Ishpeming)—Educational department graduated its first class this week. Graduates who received diplomas are miners and foremen in employ of company who have been taking prescribed work in school for over two years. New ruling of the company states that all shift bosses and foremen will be selected from among graduates. Educational work of company is in charge of Carl S. Stevenson, formerly of Bureau of Mines.

MINNESOTA

Duluth

UNIVERSAL PORTLAND CEMENT CO. (Duluth)—At present rate of construction, it is announced that company's new plant at Duluth will be in operation by Apr. 1, 1916. Plant will have output of 4000 bbl. of cement per day. It is most modern of Universal plants although not the largest. Eight hundred tons of Michigan limestone will be required daily, also 575 tons of slag from the Minnesota Steel Co.'s blast furnaces.

Cuyuna Range

WILCOX (Woodrow)—Now hoisting 500 tons daily. Initial cargo recently received at Point Edward, Ont., showed 13.5% moisture and 59% Fe, being lower in moisture than anticipated.

CUYUNA-SULTANA (Brainerd)—Company is installing some larger equipment at its No. 2 shaft, including 80-hp. locomotive-type boiler, Messinger (Duluth) hoist and Franklin air compressor. After installation shaft will be sunk 25 ft. deeper and cross cutting begun.

Mesabi Range

MEADOW (Aurora)—Shipments from stockpile started this week.

UNION (Virginia)—This mine is heaviest shipper in Virginia district at present time; 65 cars being sent out daily. Only one shift is being worked.

VIRGINIA DISTRICT—About 500 cars of ore being shipped daily from Virginia district, of which 300 come from Alpena operation of Oliver Iron Mining Co.

NORMAN (Virginia)—Oliver company is shipping 26 cars daily from this property. Two shovels are working at Minorca stockpile. Twenty-five cars are being loaded each shift. The Bessemer is sending out a like amount.

MAHONING (Hibbing)—This mine is heaviest shipper on Mesabi Range at present; shipping 210 cars daily. Buffalo-Susquehanna, also at Hibbing, comes second with 80 cars. Duluth, Mesabi & Northern road is taking care of about 54,000 tons each day.

MONTANA

Beaverhead County

NATIONAL OIL CO. (Dillon)—This company recently organized to drill for oil in Muddy Creek and Sheep Creek basin and in Small Horn Cañon near Dillon where company has located large tracts of oil land. Dr. A. C. Sandberg, of Butte, who heads company, has announced operations will begin at once.

BEAVERHEAD-MONTANA COPPER (Argenta)—Ray Cobban of Butte has lease and bond on Jackrabbit mine at Argenta and property is to be started up at once by new company which recently organized with capital stock of $100,000. Jackrabbit adjoins property of Butte-Argenta company and recent samples show ore to average 11.94% copper and 22 oz. silver. Company will ship to Salt Lake smelters but is contemplating erection of small concentrator.

Custer County

MONTANA PETROLEUM CO.—Articles of incorporation filed June 20 with clerk of Miles City. Company formed for development of gas and oil territory of Moorehead section in southeastern Montana. Upon finding oil company proposes to build plant and distill product on spot. Drilling operations will be commenced in new field as soon as necessary machinery can be brought there.

Fergus County

BARNES KING (Kendall)—Output of North Moccasin mine for May amounted to $41,044. This was secured from 4728 tons of ore, average yield per ton about $8.70.

Lewis and Clark County

EAST HELENA SMELTERY—Following visit of eastern officers of American Smelting & Refining Co. to East Helena plant, announcement was made by Manager F. M. Smith that another furnace would be blown in at once which will increase output of plant to three-fourths maximum capacity. High price of lead and zinc stimulating mining in these ores, necessitating an expansion at smeltery.

SCRATCH GRAVEL DISTRICT—New discovery has been made in this district on ground bonded by Thomas B. Miller and associates of Helena and located near celebrated Franklin property which is being worked by Cruse estate. It is in line with and about 2000 ft. distant southwesterly from present workings on Franklin lead. Shaft has been sunk on property to depth of 100 ft. and ore is to be stoped for shipment to smeltery as soon as work of running levels has been completed.

Missoula County

IRON MOUNTAIN (Missoula)—To be sold at sheriff's sale to satisfy claim of eastern capitalists. Of late was running behind causing bondholders to foreclose on mortgage.

AMADOR (Amador)—After idleness of several years has been acquired by Sydney L. Shonts and Oscar Nordquist, of Wallace, Idaho, who are preparing to erect 100-ton concentrator. Shaft is 700 ft. deep and is full of water below 400-ft. level.

Park County

MONTANA SCOTCH BONNET CO.—Property of this company, located about 60 miles from Cook City, to be opened up by eastern syndicate. About 4000 ft. of tunnels have been run and bodies of ore assaying $34 to $38 per ton have been opened up. New company intends to begin extensive development immediately.

Silver Bow County

ANACONDA (Butte)—Company has begun unwatering old Lexington mine and will work that property for its zinc ores.

BUTTE & ZENITH CITY (Butte)—Work will be resumed within short time. Mine which was closed down last fall on account of labor conditions, is located about two miles west of Rocker.

BUTTE & GREAT FALLS (Butte)—Development work at property of this company bringing promising results. Returns on samples taken from new orebody opened in crosscut that runs to Genevieve vein gave 11.5% copper, 24.4 oz. of silver and 0.08 oz. of gold. Plans to sink shaft to depth of 500 ft. or more. Hoisting engine will be installed capable to hoist ore from a depth of 1500 ft. and a large pump will be placed on 300 level.

RAINBOW DEVELOPMENT (Butte)—At annual meeting of company held in Duluth voted to issue general mortgage 6% convertible bonds to amount of $400,000 and to increase shares from 80,000 to 150,000. Par value to remain $10. Work is to be resumed at once in shaft where operations were discontinued last fall. Rainbow property adjoins Butte & Superior and has already encountered vein in which Butte & Superior's richest ores occur. Work is to be prosecuted vigorously.

BUTTE & SUPERIOR (Butte)—New flotation machines installed some weeks ago at mill of this company proved satisfactory. Grade of concentrates was raised materially and cost of production lowered. Tons of ore milled in May were 43,380. Tons of concentrates realized were 11,870. Zinc in the concentrates was 12,371,000 lb. Recovery was 88.03%. Concentrates assayed 52.11% zinc. On June 19 company filed regular monthly statement of operations in flotation plant with clerk of court showing 37,633 tons of ore treated in May in flotation plant. Amount of concentrates recovered was 7508 tons. Cost per ton of concentrates recovered, $4.28, and value per ton, $63.82. Total value of concentrates, $479,-181. Assay returns of concentrates were: Zinc, 52.055%; lead, 2.767%; copper, 0.558%; silver, 24.149 oz.; gold, 0.0418 oz.

Yellowstone County

ROMAR OIL COMPANY—Will soon commence drilling for oil in Big Wall country, northeast of Roundup and is now negotiating with landowners for leases and oil grants. Same company prospected in Seventy-nine country last year. It is understood company intends to secure leases on 45,000 acres of land.

NEVADA

Clark County

SULTAN—This property, situated near Ripley, was recently purchased by Henry Robbins, who is shipping about 200 tons of zinc carbonate ore monthly.

BULLION (Goodsprings)—Young & Fayle announce that 50-ton dry concentrator will be erected on property at once. Plans for mill are now being made, and it is expected that Sutton, Steele & Steele tables will be used.

FREDERICKSON (Goodsprings)—New dry concentrator now operating at full capacity, and Sutton, Steele & Steele tables are proving successful in handling lead-zinc carbonates. Company is treating custom ore in additon to their own production.

YELLOW PINE (Goodsprings)—Mill producing full contractual allowance of 1500 tons of zinc concentrate per month, together with 200 tons of lead-silver concentrate. Sinking has been resumed in main two-compartment shaft to tap orebody at depth of 900 ft.

ANCHOR (Goodsprings)—Full tonnage of zinc carbonate ore allowed by contract being shipped. Company announces intention of erecting 50-ton dry concentrating mill for treat-

ment of mixed lead-zinc ores. Rolls and dry tables of Stebbins type will probably be used. Roy W. Moore is superintendent.

Esmeralda County

JUMBO EX (Goldfield)—Has increased shipments from 50 tons daily to 150 tons every two days.

FLORENCE (Goldfield)—Is again considering sinking shaft from 1200 to 2000-ft. level.

ORIZABA (Cloverdale)—Property situated six miles west of Cloverdale on Luning Road purchased by L. L. Patrick, of Goldfield, and others. Shaft is down 100 ft., exposing ledge of ore carrying high gold and silver values.

Humboldt County

MERRIFIELD LEASE (Haystack)—Five-stamp mill installed has started up successfully.

Lyon County

YERRINGTON BULLION (Ludwig)—Buildings and equipment will be sold at sheriff's sale to satisfy creditors.

Nye County

CASH BOY (Tonopah)—First shipment of ore made recently to Western Ore Purchasing Co., Millers.

SKAGGS (Round Mountain)—Lease and bond taken on this property by Elko men. Large tonnage medium-grade copper ore developed.

BIG PINE (Manhattan)—New machinery for mill operating on Muskett-Wittenberg lease now arriving and being installed. New 50-hp. hoist has already been set up.

BIG FOUR (Manhattan)—After more than year's idleness, lease granted to Kendall & Bragg, of Goldfield who will start work at once. There is 10-stamp mill on ground.

DEXTER-WHITECAPS (Manhattan)—At special meeting of stockholders held at Tonopah decided to dissolve old corporation and form new one with capitalization of $2,000,000.

Storey County

MEXICAN (Virginia)—On 2300 level work in understope in north drift continued and 30 tons of ore averaging $12.50 per ton extracted. Repairs to mill continued.

COMSTOCK PUMPING ASSOCIATION (Virginia)—Pumps ran successfully all week and water held below 2700 ft. point. East drift being timbered, cleaned out and drains enlarged.

CON. VIRGINIA AND OPHIR (Virginia)—On 1600 level and Ophir 2500 level jointly with Pumping Association have been cleaning out and repairing main north drift from incline station. Distance of 26 ft. made. Total now open, 48 ft. with caved ground ahead.

OPHIR (Virginia)—At Central tunnel completed timbering intersection of two north drifts and west crosscut; and preparing to continue old slope in northerly direction. Crosscut near Andes line was timbered and crosscut in Andes ground advanced to 54-ft. point with face in porphyry and quartz. From development and stope above north drift 275 cars of ore saved and 245 tons milled.

JACKET-CROWN POINT-BELCHER (Gold Hill)—Reported that 1083 tons of dump rock sent to mill; two bars of bullion shipped to smeltery. Pumping equipment formerly in Jacket incline installed at 1500 level and placed in operation. Incline being cleaned out and repaired. On Belcher 1300 level southeast drift yielded seven cars low-grade rock. Repairs being made on 1300 and 1400 levels.

UNION CON. (Virginia)—On 2650 level west crosscut advanced to 690 ft. point; face shows porphyry and quartz. Passed through 6-in. stringer that sampled $17.50 per ton. North drift from west crosscut on south boundary line cleaned out and repaired to the 165-ft. point. On 2500 level jointly with Sierra Nevada made good progress opening up west country for prospecting. West crosscut now in good condition to 164-ft. point.

NEW MEXICO

Grant County

BURRO MOUNTAIN (Tyrone)—Extensive grading is being done from company's railroad to new townsite. Contracts have been let for erection of dwelling houses, hospital and stores.

VIRGINIA DISTRICT (Lordsburg)—A 3½-mile spur, from Oil Siding to mines in Virginia Mining District is to be built by Arizona & New Mexico R.R. Contracts have been signed with producing companies and options for rights of way secured. Grading contract is being advertised and bids will be opened at the A. & N. M. offices in Clifton, Ariz. Railroad will be in operation by Sept. 1. Caterpillar tractors now on ore haul will be moved to other mines. Construction of Lordsburg spur will mean opening of now dormant mines and increase of production of mines now operating.

SOUTH DAKOTA

Lawrence County

WASP NO. 2 (Flatiron)—Property is again being operated at close to maximum capacity, which is 500 tons daily, after working day-shift only in mine during winter months.

HILL CITY DEVELOPMENT (Hill City)—Steam hoisting plant and compressor are being set up at main shaft. Shaft down 100 ft. and will be continued to 300 ft. followed by drifting on orebodies.

BISMARCK (Flatiron)—Resumption of milling is planned, property having reverted to original owner, John A. Sandholm, Des Moines, Ia., through failure of company to complete purchase. First work to be undertaken will be construction of skipway from mill down hill to C. B. & Q. railway tracks below, over which supplies can be delivered.

ECHO (Maitland)—After suspension of mining since Apr. 29, unwatering of shaft was commenced on June 16. Water will be handled by Cameron No. 5 sinker, operated by compressed air, to furnish air for which 10x12 single-stage compressor, driven by 30-hp. motor, has been erected. Shaft is 135 ft. deep and will be continued with two shifts of miners.

UTAH

Beaver County

BEAVER GOLD (Beaver City)—Arrangements for sinking another 100 ft. have been made.

MAJESTIC (Milford)—Development is being done from 100 and 200 levels at this company's Hoosier Boy property, after shutdown of several months.

LEONORA (Milford)—East-west fissure opened on 400 level shows streak of ore widening as point of intersection with a north-south fissure approaches. This is 30 ft. distant.

NOONDAY (Milford)—Following recent strike at adjoining Cave mine, it is proposed to resume work here. Property opened to depth of 230 ft. and iron ore carrying copper has been found.

Juab County

TINTIC ORE SHIPMENTS for the week ended June 18 were 142 cars estimated at 7100 tons, valued at $177,000, compared to 124 cars week previous; about 900 tons increase.

TINTIC MILLING (Silver City)—Articles of incorporation have been filed, capitalization amounting to 1,000,000 shares, par value 3c. Jesse Knight is president and G. H. Dern, vice-president.

CHIEF CONSOLIDATED (Eureka)—Working forces have been increased, and output for week ended June 18 was 27 cars. Several blocks of ground on 1400 and 1600 levels have been given over to leasers, and more are to follow.

IRON BLOSSOM (Silver City)—Ore has not been found in commercial quantity in cave recently opened by winze from 600 level of No. 3 workings. Prospecting at depth is being continued in this section, productive at higher levels. Twenty-two cars of ore were shipped week ended June 18.

Grand County

GREEN MOUNTAIN MINING & MILLING CO. (Cisco)—Company organized under laws of Utah, 1,500,000 shares, Dr. R. S. Milbee, of Milwaukee, President. Company owns group of claims in La Sal district, 35 miles southeast of Cisco on Denver & Rio Grande R.R. Will install complete equipment of machinery, including 30-hp. gas engine, air compressor, fan. pumps, etc.

Salt Lake County

ALTA CONSOLIDATED (Alta)—A trial shipment of low-grade ore carrying copper, gold, and silver, with excess iron, is to be made as soon as teams can be obtained. Recently three cars of shipping ore were sent to market.

UTAH COPPER (Bingham)—Between 23,000 and 25,000 tons of ore daily are being treated by the Magna and Arthur mills. In May 14,053,000 lb. of copper were produced being 800,000 lb. greater than the previous record month.

CARDIFF (Salt Lake)—Shipments of 50 tons daily are being made. New oreshoot continues to open up satisfactorily; and ore has been followed downward from the main tunnel level for 75 ft. New roadway from mine is practically completed.

SOUTH HECLA (Alta)—The 500 level is producing a good tonnage of first-class ore, and 25 to 30 tons of ore daily are being shipped. As soon as surface water hampering work in the main stope has been got rid of, shipments will probably be increased. Sixteen men are working.

UTAH-APEX (Bingham)—The flotation process for the treatment of slimes will make possible an increase of nearly 10,000,000 lb. a year in output of lead, with cost of less than $20,000 for installation. At present the rate of production is 30,000,000 lb. annually. The bonded indebtedness has been reduced to $40,000; and par and interest are being offered for these but bonds are slow in coming in. Copper ore running 3 to 3½% is being shipped from 300 level, and is stated to be bringing about $10,000 monthly.

Summit County

PARK CITY ORE SHIPMENTS for week ended June 19 were 2479 tons valued at $100,000, compared to 1622 tons week previous.

SILVER KING CONSOLIDATED (Park City)—Shipments for the week ended June 18 were 1,086,640 lb.

SILVER KING COALITION (Park City)—Two shifts are being worked. The May output amounted to 4057 tons of crude ore and concentrates.

WASHINGTON

Stevens County

UNITED COPPER (Chewelah)—First unit of new stamp mill, 60 miles north of Spokane, started up. There are now 44 stamps in operation, treating 125 tons of ore. Station is being cut underground at 1000 level, and hoist equipment will be installed to sink shaft another 1000 ft.

CANADA

BRITISH COLUMBIA

CANADIAN GOLD FIELDS SYNDICATE—This company, which has not been operating since 1901, is being wound up and will make a liquidation of 4.43% to shareholders.

Ontario

ADANAC (Cobalt)—Unwatering of mine has been effected, and crosscutting begun from 200 level of No. 1 shaft. One promising vein has been encountered.

KIRKLAND LAKE (Kirkland Lake)—Rich ore has been encountered at depth of 60 ft. in shaft of McKane claim of this company. Shaft will be put down to 150-ft. level.

GLEN LAKE (Cobalt)—Lease of Foster property held by this company has been extended for another five years. Royalty has been reduced to 15% on all 200 oz. ore and under and 25% on ore of higher grade.

The Market Report

Metal Markets

NEW YORK—June 30

Copper and tin were very dull during the last week, prices remaining substantially unchanged. Lead and spelter were both stronger, particularly the latter, but the aggregate of business transacted in either metal was not large.

Copper, Tin, Lead and Zinc

Copper—The market was dull, the principal producers reporting no sales except for special brands, special shapes, for deliveries at non-competitive points. Being so well sold ahead they are quite unconcerned over the lull in buying and nominally maintain their old price of 20¼c., regular terms. Smaller producers and agencies offer copper at 19¾ @20c., regular terms. Some of these sold for delivery in Western markets, which is unusual inasmuch as back freight has to be paid to them and ordinarily they are left to sellers who have refineries further West. However, the aggregate of domestic business during the last week was small, the sales effected being principally for export to England, France and Russia. In view of the declining tendency of Sterling Exchange it is difficult to figure what such sales are going to realize unless they be made on the basis of a net cash price in New York. Considerable sales were thus made upon the basis of 19.60c., which would correspond with about 19.80@ 19.85, regular terms for the ordinary domestic deliveries.

The Anaconda Copper Mining Co. has introduced a new brand of casting copper, viz., "ABS—Arizona Best Selected." This is refined at the Raritan works from copper produced at Miami, Ariz., which is low in gold and silver, but goes 99¼ @99½% in copper.

The unusual disparity between the prices for electrolytic and casting copper—about 1c. per lb.—still prevails.

There are reports of improvement in domestic copper consumption, particularly on the part of the sheet rollers.

Copper Sheets are understood to have brought 25@26c. per lb. The principal manufacturer has withdrawn all quotations. Wire is quoted at 21½@22c. per lb. at mill.

Copper Exports for the week ended June 12 are given by the Department of Commerce at 11,064,237 lb. The larger items were 7,121,938 lb. to Great Britain and 2,921,375 lb. to France. Imports for the week were 2,518,379 lb. metal and 733,962 lb. in ore and matte; 3,252,341 lb. in all. The imports were from Peru, Canada, Cuba and Japan.

Tin—This market was quiet, only a small volume of business being reported. The deliveries in June were about 3900 tons—a large figure coming on top of the huge total of 5600 tons in May.

Tin production in Bolivia in 1914, according to official figures was 36,262 metric tons of concentrates averaging 60% tin. This is a decrease of 8332 tons from the previous year.

Tin production of the Federated Malay States, five months ended May 31, was 20,599 long tons in 1914 and 17,816 tons in 1915; a decrease of 2783 tons this year.

Lead—The outside speculative holdings appear to have been nearly all liquidated, as result of which the market gradually returned to the producers' prices, and some of the producers even made sales at their figures. At the close this market was distinctly firmer.

The exports of this metal continue heavy, as is shown in the table given on the following page.

Spelter—A moderate volume of business was done at advancing prices, particularly in the early half of the week. The bulk of this was in contracts for delivery late in the year at 18@19c. Spelter for early delivery sold up to 21c., but the market for this was spotty. This rally in the spelter market has not been characterized by any such crazy buying as there was early in June. When the price for prompt spelter rose to 21c. lots from second hands began to be offered at a little above that figure.

Exports from Baltimore for the week included 336,156 lb. spelter and 164,260 lb. zinc dross to Liverpool.

Zinc Sheets are lower; base price $27 per 100 lb., f.o.b. Peru, Ill., less 8% discount. Usual extras charged.

Other Metals

NEW YORK—June 30

Aluminum is still quite active, but seems to be in rather better supply than it has been. More domestic metal is available. Quotations are a shade easier, at 30@32c. per lb. for No. 1 ingots, New York.

Antimony remains strong, though not especially active. Business is confined to necessary supplies. Ordinary brands, chiefly Chinese and Japanese, are held at 37½@40c. per lb. Cookson's is in short supply and 47@50c. per lb. is named.

Nickel is steady and unchanged. Ordinary forms are 40@ 45c. per lb., according to size and terms of order. Electrolytic, 3c. per lb. higher.

DAILY PRICES OF METALS IN NEW YORK

June	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	St. Louis, Cts. per Lb.
24	4.7663	48¼	19.45 @19.75	41	5.50 @5.75	5.37½ @5.67½	17.50 @18.50
25	4.7725	48½	19.45 @19.75	41½	5.50 @5.75	5.50 @5.67½	17.50 @19.50
26	4.7731	48⅜	19.45 @19.75	41	5.62½ @5.75	5.50 @5.67½	18.00 @20.00
28	4.7675	48½	19.45 @19.75	40½	5.62½ @5.75	5.50 @5.67½	18.50 @21.00
29	4.7613	48	19.45 @19.75	40	5.62½ @5.75	5.50 @5.67½	18.50 @21.00
30	4.7563	48	19.45 @19.75	39¾	5.75	5.50 @5.67½	19.00 @21.00

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.20c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only the St. Louis price is herein quoted, St. Louis being the basing market. We quote the New York price at 17c. per 100 lb. above the St. Louis price.

Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are: St. Louis-New York, 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

June	Silver	Copper				Tin		Lead		Zinc	
		Standard		Electrolytic							
		Spot	3 Mos.	£ per Ton	Cts. per Lb.	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
24	23 7/16	80⅞	82	94½	20.33	168¼	166½	23¼	4.95	87½	18.63
25	23 7/16	82¼	83½	94½	20.33	171	168	24⅜	5.21	91	19.38
26	23 7/16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
28	23	82¼	83½	94½	20.33	171	168	24⅜	5.29	92½	19.59
29	22⅞	82¼	83⅜	95	20.43	171¾	168½	25 5/16	5.44	100	21.29
30	22⅞	81¾	83½	95	20.42	172	168¼	26¼	5.59	100	21.29

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for electrolytic, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅜c.

Recent London quotations for ordinary forms of refined nickel are £216 per long ton, which is equal to 46.9c. per lb.

Quicksilver is in good demand and prices continue strong. New York quotation for wholesale lots is $90@95 per flask for large lots. Smaller orders bring $95@100 per flask. San Francisco reports by telegraph a somewhat variable market, prices ranging from $85 up to $95 per flask ,with demand in excess of stocks. London has had a sharp advance, the present price being £16 per flask, with £15 17s. 6d. quoted from second hands.

Minor Metals—Current sales of bismuth are at $2.75@3 per lb. New York. The London price is quoted at 10s., or $2.40 per lb. there—**Cadmium** is quoted at 6s., or $1.44 per lb. in London; $1.50 per lb., New York.—**Tellurium** is reported sold at 80s., or $19.20, per lb. in London.—**Selenium** is quoted at $2@3 per lb. New York for larger quantities; $4.50@5 for retail lots.

LEAD AND ZINC EXPORTS

Imports and exports of lead in April and the four months ended Apr. 30 are reported by the Department of Commerce as below, in short tons:

	April		Four Months	
	1914	1915	1914	1915
Imports	2,389	3,193	7,536	22,322
Exports	3,663	25,019	5,438	49,573

The exports included reëxports of foreign lead. The imports are nearly all in ore and base bullion, sent here to be refined.

Imports and exports of zinc or spelter for April and the four months ended Apr. 30 were as follows, in short tons:

	April		Four Months	
	1914	1915	1914	1915
Exports	60	8,842	481	50,523
Imports	208	23	459	264

Imports of zinc ore in April this year were 12,988 tons, estimated as containing 12,461,830 lb. zinc.; for the four months, 27,897 tons, with 23,081,296 lb. zinc contents. Imports of zinc dust for the four months were 1,792,414 lb. this year.

METAL EXPORTS AND IMPORTS

Spanish Metal and Mineral Exports three months ended Mar. 31, as reported by "Revista Minera," in metric tons:

	Metals		Ores etc.	
	1914	1915	1914	1915
Iron	1,871	37,515	1,979,396	962,457
Copper	4,481	3,934	35,380	11,198
Copper precipitate	2,579	2,041	.....	.....
Lead	41,999	32,936	708	183
Zinc	683	487	25,444	874
Quicksilver	619	372	.....	.....
Manganese	.....	.....	5,425	1,970
Pyrites	.....	.....	776,422	333,372
Salt	.....	.....	143,868	189,367

Imports of coal for the three months were 366,305 tons, a decrease of 328,988 tons from 1914; of coke, 37,251 tons, a decrease of 54,274 tons.

Gold, Silver and Platinum

NEW YORK—June 30

Gold continues to come from Ottawa on London account. More will doubtless come, as exports to Europe increase.

Gold output of the Kolar field in Mysore, India, five months ended May 31, was $5,051,562 in 1914, and $5,250,118 in 1915; an increase of $198,556 this year.

Sterling Exchange in New York reached the lowest point on record, having sold one day at a point below 4.76, which is 2% below par.

Platinum is still quiet, with business on a moderate scale. Prices show no material change. Dealers ask $37@39 per oz. for refined platinum and $41@44 per oz. for hard metal.

Our Russian correspondent writes that the improvement in the market continues. At Petrograd there is a demand for considerable quantities for shipment abroad, especially to Sweden. At Ekaterinburg there have been good transactions in small quantities. Quotations at Ekaterinburg are 8@8.50 rubles per zolotnik—average, $31.02 per oz.; at Petrograd, 33,500@33,800 rubles per pood—average, $32.78 per oz.—for crude metal, 83% platinum.

Silver—The market has continued dull and stagnant, and owing to lack of buying orders has been forced down to 22⅞d in London. The selling pressure has been light or prices would be lower still. India is only a small buyer and China is not in the market. Price closes steadier at 48c. in New York.

Silver shipments from London to the East from Jan. 1 to June 16 are reported as below by Pixley & Abell:

	1914	1915	Changes
India	£3,617,000	£2,562,000	D. £1,055,000
China	40,000	5,000	D. 35,000
Total	£3,657,000	£2,567,000	D. £1,090,000

Imports of silver in Great Britain five months ended May 31, were valued at £4,345,647; exports, £3,697,176; excess of imports, £648,471, which compares with an excess of exports of £1,272,671 last year.

Zinc and Lead Ore Markets

JOPLIN, MO.—June 26

Blende, high price $112.50 per ton of 60% zinc; premium ore, $110@100; medium grades, $100@90; lower grades down to $70; caalmine, base 40% zinc, $75@50; average price, all grades of zinc, $96.36 per ton. Lead, high price, $75; base, $72@60 per ton 80% metal content; average price, all grades of lead, $64.35 per ton.

Producers are between opposing forces now. Prices are receding and a large number of miners went out on strike again tonight for a further raise in wages. Premium ore dropped $18 this week and $7 the previous week, and the decline is hurting. The strike among miners, it is believed, will be settled by the men returning to work Monday without advance, but if this is not done the output of the largest producing mines of Webb City will be severely curtailed.

SHIPMENTS, WEEK ENDED JUNE 26

	Blende	Calamine	Lead	Values
Totals this week	11,369,550	760,920	2,270,430	$656,490
Totals this year	299,601,790	25,187,400	43,029,300	11,774,710

Blende value, the week, $559,970; 6 months, $10,136,320.
Calamine value, the week, $23,480; 6 months, $522,660.
Lead value, the week, $73,040; 6 months, $1,115,400.

PLATTEVILLE, WIS.—June 26

The base price paid this week for 60% zinc ore was $95@110 per ton. The base price paid for 80% lead ore was $68 per ton.

SHIPMENTS, WEEK ENDED JUNE 26

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur Ore, Lb.
Week	3,449,750	80,000	747,860
Year	92,126,380	3,202,090	13,204,730

Shipped during week to separating plants, 4,516,400 lb. zinc ore.

Iron Trade Review

NEW YORK—June 30

The iron and steel markets are still gaining with large increases in orders in many lines, and with domestic as well as foreign business contributing to the improvement. Just what proportion the export business bears to the total it is not easy to say definitely, as orders for material are frequently so divided up that their ultimate destination cannot be determined. Undoubtedly it is large and includes a quantity of rail and of steel for railroad equipment as well as for the war munitions.

Naturally prices are firming up and advances are recorded in a number of lines. The upward movement is not rapid, but is generally held.

The pig-iron market is not keeping pace with steel, but is generally lagging behind. Pig iron production is increasing, but the gain is all with the steel works furnaces, and the merchant stacks are making little progress, hardly holding their own.

The ferromanganese situation is not improving, and it looks as if the shortage might be a serious one before long. Some manganese ore is coming in, but receipts are much below last year. The English receipts also show a heavy decrease.

Exports from Baltimore for the week included 17,799,804 lb. billets and skelp steel, 3,420,700 lb. bars and wire rods, all to Great Britain.

Imports at Baltimore for the week included 8360 tons manganese ore from Brazil and 2017 tons ferromanganese from Liverpool.

Foreign Trade of the United States in iron and steel and in manufactures thereof four months ended Apr. 30 is valued by the Department of Commerce as follows:

	1914	1915	Changes
Exports	$74,414,334	$80,812,326	I. $6,397,992
Imports	10,306,027	5,948,722	D. 4,357,305
Excess, exports	$64,108,307	$74,863,604	I. $10,755,297

The incerase in exports this year, as compared with 1914, was 8.6%; while there was a decrease of 42.3% in the imports.

PITTSBURGH—June 29

The steel mills are now operating at slightly more than 80% of rated capacity, and operations are still increasing, pointing to a 90% operation or better by the beginning of August. There will be no dull summer in the steel trade this year. Yesterday the Carnegie Steel Co. started the North Sharon works, for the first time in about two years, and now has only one idle steel plant, the small Columbus bessemer works. This plant will not be started in the near future, as recently reported, but if additional billets and sheet bars are required the Riverside plant at Wheeling or the National Tube Co. will be started for this purpose. The Carnegie Steel Co. is negotiating for billets and sheet bars to apply against some of its obligations in the East, particularly for the Pencoyd works of the American Bridge Co. It only buys steel when under unusual pressure.

Exports of steel that are reported by weight are expected to total between 250,000 and 300,000 gross tons for June, against 223,000 tons in April, for which month the government statistics have just been published. Exports of manufactures involving steel, not reported by weight, are unusually heavy, exports of passenger automobiles and trucks, machine tools, locomotives and freight cars being unusually heavy, while shrapnel, loaded and unloaded, not reported in the statistics by weight, involve a large quantity of steel. Altogether the exports of steel and manufactures involving steel now represent fully 20% of the current steel output, and may possibly amount to nearly 25%, the export rate exceeding the average rate in 1912, the banner export year.

Steel prices show only a slight advancing tendency, the strength of the market being shown chiefly by the heavy bookings for early deliveries and the indisposition of the mills to book for late deliveries. As a whole the actual shipping orders entered run from 15 to 30% above the current shipments. The Pittsburgh and western mills have nearly all withdrawn the 1.20c. price on bars, plates and shapes for prompt shipment, and are quoting 1.25c. for prompt or third quarter. Some mills east of Pittsburgh are still on the 1.20c. basis. Railroad spikes are up $1 a ton to 1.40c., and cold rolled strip steel is up $8, to 2.85c., base. Shafting is firming up, with 68% off list difficult to do and some producers quoting 66% off list.

The iron mill wage scale of the Amalgamated Association was arranged on Saturday at Atlantic City, on the basis of continuing the present scale for the twelvemonth. The men had asked advances, but the iron mills have not participated in the steel trade improvement sufficiently to be willing to grant any advances.

Pig Iron—The local pig iron market continues quiet, not showing any improvement, when the steel trade proper has improved so much. Recent sales to Westinghouse interests, instead of being at exeeptionally low prices, now prove to be at prices that can be done again, and the market on Valley foundry iron is quotable 25c. lower than formerly, making the lowest level since 1904. Girard furnace in the Mahoning Valley will blow out this week, after being in blast only three or four months, finding prices obtainable unremunerative. We quote: Bessemer, $13.75; basic, $12.65@12.75; fouadry and malleable, $12.50@12.75; forge, $12.25@12.50, f.o.b. Valley furnaces, 95c. higher delivered Pittsburgh.

Ferromanganese—Small spot lots are commanding $105@115, regular contracts remaining at $100, Baltimore.

Steel—The Pittsburgh mills are practically out of the market and the Youngstown mills, with a little unsold capacity, are conserving this supply and quoting advanced prices, at about $20 for billets and $21 for sheet bars, prices delivered Pittsburgh being $1.05 higher. Rods are stronger, at $25.50@26, Pittsburgh.

FOREIGN IRON

Steel production in Germany in April was 1,012,344 metric tons, being 85,929 tons less than in March. For the four months ended Apr. 30 the total this year was 4,020,298 tons.

IRON ORE

Statistics compiled by the Lake Superior Iron Ore Association show that the shipments of ore from docks to furnaces during May amounted to 2,797,481 tons. The tonnage on dock June 1 was 5,970,115, compared with 5,772,462 tons on dock June 1 last year.

Imports at Baltimore for the week included 1600 tons manganese ore from Spain and 1731 tons from Liverpool, 3331 tons in all.

Exports of manganese ore from India in the fiscal year ended Mar. 31 were 718,040 tons in 1913-14 and 440,590 tons in 1914-15; a decrease of 277,450 tons.

Imports of manganese ore in Great Britain five months ended May 31 were 205,217 tons in 1914, and 107,297 tons in 1915; decrease, 97,920 tons.

Imports of Iron Ore into the United States in April were 91,561 tons, which is 3159 tons more than in March, but 20,251 tons less than in April, 1914. The chief items were 73,811 tons from Cuba, 18,725 from Sweden, 7800 from Newfoundland and 6256 from Spain. For the four months ended Apr. 30 the imports were 394,739 tons in 1914, and 334,022 in 1915; a decrease of 60,727 tons this year.

Imports of Iron Ore in Great Britain five months ended May 31 were 2,070,224 long tons in 1914, and 1,939,719 in 1915; decrease 130,505 tons.

OTHER ORES

Recent quotations for rare ores in Great Britain are: Molybdenite, 90% MoS_2, $28.80 per unit. Tungsten ore, wolfram, over 65% WO_3, $9.60 per unit; scheelite, 70%, $9.36@9.60 per unit.

Tungsten, Ore.—The schedule of prices now paid for tungsten ore delivered at the Primos Mill, is as follows: $2 a unit for 1% ore, with an increase of 50c. a unit for each additional unit up to 5%, which is worth $4 a unit; an increase of 10c. a unit up to 40% ore, which is worth $7.50 a unit; then an increase of 5c. a unit up to 50% ore, which is worth $8 a unit; then an increase of 10c. a unit up to 60% ore, which is worth $9 a unit. The sampling charge on lots assaying less than 2% is $2 a ton. On small lots worth less than $50 a charge of $5 is made for sampling and assaying. The Primos mill is at Lakeville, Colo., in the district where most of the ore is mined.

FERRO-ALLOYS

Recent quotations for ferro-alloys in Great Britain are as follows: Ferrochrome, from $121.67 per ton for 10% carbon up to $155.75 for 4% carbon. Ferrosilicon, 25%, $51 per ton; 45%, $70.50 per ton. Ferromolybdenum, 70-80%, $4.32 per lb. Ferrotungsten, $1.34 per lb. for 75-85% tungsten and under 1% carbon; tungsten metal, powder, $1.46 per lb. for 96-98% pure.

COKE

Connellsville—The wage cuts made in the fore part of 1914 by the majority of independent coke producers are being eliminated by a return to the Frick scale, announcements to this effect having already been made by the Connellsville Central Coke Co., the Struthers Coal & Coke Co., the Republic Iron & Steel Co., the Bessemer Coke Co. and the Washington Coal & Coke Co. The last named had a strike last week which was settled by restoring the old rates and others have been posting announcements to hold their men, as a labor shortage is regarded as certain in the near future. The merchant coke market, however, remains dull. The wage advance will doubtless stiffen operators' views and may correspondingly delay further buying. We quote: prompt furnace, $1.50@1.55; contract to Jan. 1, $1.75; prompt foundry, $2@2.50; contract, $2.20@2.50, per net ton at ovens.

Chemicals

NEW YORK—June 30

The general market is gradually steadying and shows a better tone on moderate business in most lines.

Arsenic—Demand is only fair, but prices show no change. Quotations are about $4 per 100 lb. for both spot and futures.

Copper Sulphate—Business is steady, with no material change in prices. Quotations are $7.25 per 100 lb. for carload lots and $7.50 per 100 lb. for smaller orders.

Nitrate of Soda—The market continues strong and steady, although transactions are rather variable in quantity. Quotations are 2.20c. per lb. for spot and all positions this year.

Potash Salts—The Department of Commerce reports that the imports of potash salts into the United States for the five months ended May 31 were, in pounds:

	1914	1915
Carbonate of potash	9,867,075	8,396,034
Hydrate of potash	3,462,638	2,016,942
Nitrate of potash	1,079,045	6,855
Cyanide of potash	275,977	828,527
Other potash sales	2,704,391	2,064,260

The imports of potash salts used as fertilizers were as follows for the five months, in long tons:

	1914	1915
Kainit	239,362	3,786
Manure salts	81,669	12,456
Sulphate of potash	21,313	8,806
Muriate of potash	105,759	56,135

The large decreases this year are, of course, due to the stoppage of imports from Germany.

Assessments

Company	Delinqe	Sale	Amt.
Belcher, Nev., (post.)		July 8	$0.15
Best & Belcher, Nev., (post.)		July 8	0.05
Blue Bell, Ida	July 5	Aug. 4	0.003
Blue Star, Ida	June 19	July 10	0.01
Carbonate, Ida	June 23	July 23	0.001
Challenge Con., Nev	July 12	Aug. 4	0.05
Con. Virginia, Nev	July 19	Aug. 10	0.05
*Contact Copper, Mich		July 14	0.50
Contact Copper, Mich	May 15		0.50
Crown Point, Nev., (post.)	June 16	July 8	0.15
Duluth, Ida	June 5	July 8	0.001
Glen Metal, Ida	May 31	July 1	0.002
Hancock Cons., Mich	Sept. 1		1.00
Hancock Cons., Mich	Jan. 3		1.00
Houghton, Mich	May 25		1.00
Idaho-Nevada, Ida	July 14	Aug. 6	0.001
Idora, Ida	June 3	July 2	0.005
Iron Mask, Ida	July 1	Aug. 10	0.002
Majestic-Idol, Nev	Dec. 15	July 20	0.005
Mayflower, Ida	June 15	July 17	0.005
Mineral Range, Utah	May 24		0.003
Monarch Pi.ts., Nev	June 14	July 14	0.01
Moonlight, Ida	June 5	July 8	0.005
Nabob, Ida	July 5	Aug. 2	0.005
New Arcadian, Mich	June 1		0.50
New Arcadian, Mich	Dec. 1		0.50
New Baltic, Mich	July 15		0.50
New Baltic, Mich	Jan. 15		0.50
New Yerrington Cop., Nev	July 9	July 27	0.01
North Bunker Hill, Ida	June 12	July 17	0.002
Old Veteran, Ida	July 5	July 31	0.002
Rainbow, Ida	July 7	Aug. 7	0.002
Revelator, Utah		July 16	0.00½
Revelator, Utah	Aug. 17	Sept. 3	0.00½
Revelator, Utah	Oct. 4	Oct. 25	0.00½
Rhode Island, Ida	June 24	July 24	0.001
Royal, Ida	June 1	July 6	0.0015
Silver Mountain, Ida., (post.)		July 15	0.002
Silver Pick, Nev	June 5	July 12	0.01
Sunrise, Ida	July 17	Aug. 17	0.002
Sunset Dev., Ida	June 30	July 24	0.0025
Umatilla Tonopah, Nev	July 12	Aug. 16	0.01
Union, Nev	June 18	July 9	0.05
West Tonopah Con., Nev	July 10	Aug. 10	0.01
Yellow Jacket, Nev., (post.)	June 14	July 8	0.15

*This assessment was levied and payable Apr. 27, '14.

Stock Quotations

Sales at auction during the last week included: 1500 West Coast Smelting & Refining, $10 par, 35c. per share; $500 Consol. Nevada-Utah convertible 6's, 1918-1922, $100 lot. The New York Stock Exchange has listed $15,000,000 collateral trust 7% bonds of the Chile Copper Co.

COLO. SPRINGS June 29		SALT LAKE June 29	
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	.03	Beck Tunnel	.04
Cripple Cr'k Con	.01	Black Jack	.09½
C. K. & N	.03	Colorado Mining	.11½
Doctor Jack Pot	.10½	Crown Point	.01½
Elkton Con	.39½	Daly-Judge	7.25
El Paso	.94	Gold Chain	.15
Findlay	.04½	Grand Central	.60
Gold Dollar	.02	Iron Blossom	.83
Gold Sovereign	.04½	Little Bell	.10
Golden Cycle	1.80	Lower Mammoth	.03
Isabella	.18	Mason Valley	‡2.50
Jack Pot	.06½	May Day	.16
Jennie Sample	‡.02	Opohongo	.00½
Jerry Johnson	.04	Prince Con	.63
Lexington	.005	Seven Troughs	.01½
Mary McKinney	.36	Silver King Coal'n	3.42½
Pharmacist	.01	Silver King Con	2.00
Portland	1.45	Sioux Con	.03
Raven B. H.	.02	Uncle Sam	.05½
Vindicator	1.71½	Yankee	.04

TORONTO June 29			
Bailey	.01½	Dome Exten	.13
Coniagas	.05	Foley O'Brien	.30
Peterson Lake	.22	Hollinger	25.50
Right of Way	.04	Imperial	.05½
Seneca Superior	.00½	Jupiter	.09
Silver Queen	.01	McIntyre	.47
T. & Hudson Bay	‡18.50	Pearl Lake	.01
Timiskaming	.32	Porcu. Crown	.75
Wettlaufer-Lor	.03	Preston E. D.	.02
Big Dome	17.12½	Rea	.10

SAN FRANCISCO June 29			
Comstock Stocks		Misc. Nev. & Cal.	
Alta	‡.04	Belmont	4.05
Andes	.05	Jim Butler	.90
Belcher	.32	Lone Star	.05
Best & Belcher	.06	MacNamara	.02
Caledonia	.22	Midway	.16
Challenge Con	‡.06	Mont.-Tonopah	.25
Confidence	.06	North Star	.15
Con. Virginia	.06	Rescue Eula	.08
Gould & Curry	.02	West End Con	.83
Hale & Norcross	.04	Atlanta	.30
Julia	‡.02	Booth	.49
Mexican	.37	C.O.D. Con	.03
Occidental	.79	Comb. Frac	.08
Ophir	.11	Jumbo Extension	1.60
Overman	.06	Pitts.-Silver Peak	‡.12
Potosi	‡.03	Round Mountain	.51
Savage	.04	Sandstorm Kendall	.09
Sierra Nevada	.04	Silver Pick	.11
Union Con	.16	Central Eureka	‡.16
Yellow Jacket	.36	So. Eureka	‡1.50

N. Y. EXCH. June 29		BOSTON EXCH June 29	
Name of Comp.	Cig.	Name of Comp.	Cig.
Amalgamated	74½	Adventure	‡2½
Am.Sm.&Ref.,com	79	Ahmeek	399
Am. Sm. & Ref., pf.	107	Alaska Gold M	38
Am. Sm. Sec., pf. B.	79	Algomah	‡3
Anaconda	36	Allouez	56
Batopilas Min	1½	Am. Zinc	54⅛
Bethlehem Steel	168	Ariz. Com., ctfs	7½
Bethlehem Steel, pf.	116	Bonanza	‡35
Chino	45½	Butte-Balaklava	3
Colo. Fuel & Iron	30½	Butte & Superior	70½
Federal M. & S., pf.	45	Calumet & Ariz	64½
Great Nor., ore., ctf.	36	Calumet & Hecla	585
Guggen. Exp	63½	Centennial	19
Homestake	118	Cliff	‡1½
Inspiration Con	31	Copper Range	54
Mex. Petroleum	74	Daly West	3½
Miami Copper	26	East Butte	12½
Nat'l Lead, com	63½	Franklin	10
National Lead, pf	109⅛	Granby	88
Nev. Consol	14½	Hancock	17½
Ontario Min	3½	Hedley	‡28
Quicksilver, pf	3	Helvetia	.60
Ray Con	23⅛	Indiana	6½
Republic I&S, com	29½	Island Cr'k, com	48
Republic I&S, pf	87	Island Cr'k, pfd	88½
SlossSheff'd, com	34	Isle Royale	‡28
Tennessee Copper	37	Keweenaw	3½
Utah Copper	67⅛	Lake	13⅜
U. S. Steel, com	60⅛	La Salle	‡6½
U. S. Steel, pf	109½	Mass	‡13½
		Mayflower	4½
N. Y. CURB June 29		Michigan	1½
Alask a Juneau	13½	Mohawk	79
Alta Con	.72	New Arcadian	11½
Beaver Con	‡.32	North Butte	32½
Big Four	‡.05	North Lake	2½
Blue Bell	‡.03	Ojibway	‡2
Braden Copper	7⅛	Old Colony	4
Buffalo Mines	‡.50	Old Dominion	55
Can. Cop. Corpn	1 1/16	Osceola	90½
Can. G. & S	‡.03	Quincy	‡87
Caribou	‡.50	Santa Fe	‡3
Cashboy	.07	Shannon	9
Chambers Feriand	‡.16	Shattuck-Ariz	28
Chile Cop	20½	Superior	‡29½
Con. Ariz. Sm	1	Superior & Bost	3½
Con. Coppermines	‡2½	Tamarack	‡37
Con. Nev.-Utah	7/16	Trinity	5
Davis-Daly	‡1⅛	Tuolumne	.49
Diam'field-Daisy	‡7	U. S. Smelting	44
Dia. Black B	.04	U. S. Smelt'g, pf	47½
Florence	.52	Utah Apex	4 5/16
Goldfield Con	1 5/16	Utah Con	‡14⅛
Goldfield Merger	.22	Victoria	3
Greene Cananea	39½	Winona	4
Kennicott Cop	33⅛	Wolverine	62
Kerr Lake	4½	Wyandot	‡1
La Rose	.50		
McKinley-Dar-Sa	.22	BOSTON CURB June 29	
Majestic	.99	Name of Comp.	Bid.
Mines of Am	‡2½	Alvarado	.50
Nevada Hills	.21	Bingham Mines	.09⅜
New Utah Bingham	4	Boston Ely	.25
Nipissing Mines	5⅛	Butte & Lon'n Dev	.22
Ohio Copper	‡.22	Calaveras	1⅞
Oro	.10	Calumet-Corbin	.05
South Utah	‡½	Chief Con	1.12½
Stand'd Oil of N.J.	394	Corbin	.50
Standard S. L	1 1/16	Cortez	.30
Stewart	2 1/16	Crown Reserve	.75
Tonopah	‡7⅛	Eagle & Blue Bell	1.75
Tonopah Ex	3	First Nat. Cop	2⅛
Tonopah Merger	.42	Houghton Copper	4
Tribullion	1½	Iron Cap Cop., pf	.06
Tularosa	7/16	Majestic	.99
Yukon Gold	2⅛	Mexican Metals	.25
		Nevada-Douglas	.45
LONDON June 17		New Baltic	3½
Alaska Tre'dwell	£7 5s 0d	Oneco	1⅛
Cam & Motor	0 14 9	Raven Copper	.10
Camp Bird	0 5 0	Smokey Dev	.15
El Oro	0 7 3	So. Lake	6½
Esperanza	0 7 0	Tonopah Victor	.32
Mexico Mines	3 12 6	Trethewey	.09
Oroville	0 14 0	United Verde Ext	4 7/16
Santa Gert'dis	0 7 6		
Tomboy	1 1 3		
Tough Oakes	0 8 6		

‡Last Quotations.

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1913	1914	1915	1913	1914	1915
January	62.938	57.572	48.855	28.983	26.553	22.731
February	61.642	57.506	48.477	28.357	26.573	22.753
March	57.870	58.067	50.241	26.669	26.788	23.708
April	59.490	58.519	50.250	27.416	26.958	23.709
May	60.361	58.175	49.915	27.825	26.704	23.570
June	58.990	56.471	49.034	27.199	25.948	23.267
July	58.721	54.678		27.074	25.219	
August	59.293	54.344		27.335	25.979	
September	60.640	53.290		27.986	24.260	
October	60.793	50.654		28.083	23.199	
November	58.995	49.082		27.263	22.703	
December	57.760	49.375		26.720	22.900	
Year	59.791	54.811		27.576	25.314	

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York		London			
	Electrolytic		Standard		Best Selected	
	1914	1915	1914	1915	1914	1915
January	14.223	13.641	64.304	60.756	69.488	65.719
February	14.491	14.394	65.259	63.494	70.188	*
March	14.131	14.787	64.276	66.152	69.170	*
April	14.211	16.811	64.747	75.069	69.313	*
May	13.991	18.506	63.182	77.600	67.786	*
June	13.603	19.477	61.336	82.574	66.274	95.333
July	13.223		60.540		64.955	
August	*		‡		‡	
September	*		‡		‡	
October	*		‡		‡	
November	11.739		53.227		*	
December	12.801		56.841		*	
Year						

TIN

Month	New York		London	
	1914	1915	1914	1915
January	37.779	34.260	171.905	156.550
February	39.830	37.415	181.556	176.925
March	38.038	48.426	173.619	180.141
April	36.154	47.884	163.963	166.225
May	33.360	38.790	150.702	162.675
June	30.577	40.288	138.321	167.636
July	31.707		142.517	
August	*		‡	
September	32.675		‡	
October	30.284		‡	
November	33.304		139.391	
December	33.601		147.102	
Av. year	34.301			

LEAD

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	4.111	3.729	4.011	3.548	19.665	18.606
February	4.048	3.827	3.937	3.718	19.606	19.122
March	3.970	4.053	3.850	3.997	19.651	21.883
April	3.810	4.221	.688	4.142	18.225	21.094
May	3.900	4.274	3.808	4.182	18.503	20.347
June	3.900	5.932	3.810	5.836	19.411	25.170
July	3.891		3.758		19.051	
August	3.875		3.715		‡	
September	3.828		3.658		‡	
October	3.528		3.384		‡	
November	3.683		3.585		18.500	
December	3.800		3.662		19.097	
Year	3.862		3.737			

SPELTER

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	5.262	6.386	5.112	6.211	21.533	30.844
February	5.377	8.436	5.228	8.255	21.413	39.819
March	5.250	8.541	5.100	8.366	21.460	44.141
April	5.113	10.012	4.963	9.837	21.569	49.888
May	5.074	14.781	4.924	14.610	21.393	68.100
June	5.000	21.208	4.850	21.038	21.345	100.61
July	4.920		4.770		21.568	
August	5.568		5.418		‡	
September	5.380		5.230		‡	
October	4.909		4.750		‡	
November	5.112		4.962		25.016	
December	5.592		5.430		27.369	
Year	5.213		5.061			

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton. * Not reported, ‡ London Exchange closed.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1914	1915	1914	1915	1914	1915
January	$14.94	$14.59	$13.23	$13.45	$13.99	$13.90
February	15.06	14.55	14.12	13.45	14.08	13.90
March	15.07	14.55	13.94	13.45	14.10	13.95
April	14.90	14.55	13.90	13.45	14.13	13.95
May	4.90	14.61	13.90	13.60	14.27	13.83
June	14.90	14.70	13.90	13.59	13.96	13.77
July	14.90		13.90		13.90	
August	14.90		13.90		14.08	
September	14.90		13.90		14.03	
October	14.84		13.75		13.97	
November	14.59		13.43		13.83	
December	14.70		13.45		13.83	
Year	$14.88		$13.78		$14.01	

The Mining Index

This index is a convenient reference to the current literature of mining and metallurgy published in all of the important periodicals of the world. We will furnish a copy of any article (if in print) in the original language for the price quoted. Where no price is quoted, the cost is unknown. Inasmuch as the papers must be ordered from the publishers, there will be some delay for foreign papers. Remittance must be made with order. Coupons are furnished at the following prices: 20c. each, six for $1, 33 for $5, and 100 for $15. When remittances are made in even dollars, we will return the excess over an order in coupons, if so requested.

COPPER

1311—ALLOYS—Titanium-Aluminum Bronze. W. M. Corse and Charles Vickers. (Metal Ind., May, 1915; 1¾ pp.) 20c.

1312—AURIFEROUS BOTTOMS—Note on the Concentration of Gold in Bottoms in the Converter. H. F. Collins. (Bull. 128, I. M. M., May 13, 1915; 8 pp.) 40c.

1313—CHILE COPPER CO. Ready for Operations. (Min. and Eng. Wld., May 29, 1915; 1¾ pp., illus.) 20c.

1314—CHUQUICAMATA—The Leaching-Plant at Chuquicamata. Lincoln C. Rogers. (Min. Mag., May, 1915; 6 pp., illus.) 40c.

1315—COPPER REFINING—Ueber die elektrolytische Kupferraffination. Franz Altneder. (Metall u. Erz., May 8, 1915; 5½ pp., illus.) An elementary article on copper refining.

1316—LEACHING—A Case for Copper Hydrometallurgy. Inexpensive and Efficient Treatment of Smelter Flue Dust and Carbonate Ore. Geo. C. Westby. (Met. and Chem. Eng., May, 1915; 2 pp., illus.) 40c.

1317—OKLAHOMA—Copper Deposits in the "Red Beds" of Southwestern Oklahoma. A. E. Fath. (Econ. Geol., Feb.-Mar., 1915; 11 pp., illus.)

1318—SOUTH AUSTRALIA—Pernatty Copper Deposits, South Australia. J. Andrew Wauchope. (Min. and Eng. Rev., Apr. 5, 1915; 3 pp.) 40c.

1319—SMELTING Methods at Magistral, Durango, Mex. Robert W. Bissell. (School of Mines Quart., Nov., 1914; 8 pp.) 40c.

GOLD DREDGING AND PLACER MINING

1320—ALASKA—Koyukuk Placer-Mining District. (Eng. and Min. Journ., June 12, 1915; 1¼ pp.) 20c.

1321—DEVELOPMENT METHODS at Fairbanks. Hubert I. Ellis. (Eng. and Min. Journ., June 12, 1915; 6¾ pp., illus.) 20c.

1322—METALLURGY—The Metallurgy of Alluvial Mining. John M. Nicol. (Min. and Sci. Press, May 29, 1915; 4 pp., illus.) 20c.

1323—VALUATION of Dredging Ground. J. J. Bristol. (Min. and Sci. Press, May 29, 1915, ½ p., illus.) 20c.

GOLD AND SILVER CYANIDING

1324—CHURCHILL MILLING CO.—Cyaniding Practice of Churchill Milling Co., Wonder, Nev. E. E. Carpenter. (Bull. A. I. M. E., June, 1915; 15 pp., illus.)

1325—MINERALIZED WATERS—Discussion on "The Effect of Mineralized Waters in Cyanide Plants." Thomas B. Stevens and W. S. Bradley. (Bull. 128, I. M. M., May 13, 1915; 1¼ pp.) 40c.

1326—PRECIPITATION—Discussion on "The Precipitating Action of Carbon in Contact with Auriferous Cyanide Solutions." W. R. Feldtmann. (Bull. 128, I. M. M., May 13, 1915; 16½ pp.) 40c.

1327—RAND—Metallurgical Practice in the Witwatersrand District, South Africa. F. L. Bosqui. (Advance copy, A. I. M. E., Sept., 1915; 37 pp., illus.)

1328—SOLUTIONS—Assay of Cyanide Solutions. C. E. Roodhouse. (Min. and Sci. Press, May 15, 1915; ¾ p.) 20c.

1329—SOLUTION—The Morro Velho Method of Assay of Gold-Bearing Cyanide Solutions. Donald M. Levy and Harold Jones. (Bull. 128, I. M. M., May 13, 1915; 2¼ pp.) 40c.

1330—TESTING OF ORES for the Cyanide Process. Welton J. Crook. (Pahasapa Quart., May 1915). Continuation of article previously indexed.

1331—TESTING SOLUTIONS—Notes on the Practical Testing of Working Cyanide Solutions. Edward H. Groghan. (Journ. Chem., Met. and Min. Soc. of So. Afr., Apr., 1915; 5 pp., illus.) 60c.

1332—TUBE MILL—The Use of Scoop Discharges in Tube-Mills. Walford R. Dowling. (Journ, Chem., Met. and Min. Soc. of So. Afr., Mar., 1915; 6 pp., illus.) 60c.

GOLD AND SILVER—GENERAL

1333—AMALGAM EFFICIENCY—The Relative Efficiency of Various Amalgams in the Recovery of Gold. Francis A. Thomson and Robert Keffer. (Met. and Chem. Eng., June, 1915; 3½ pp.) 40c.

1334—COBALT LAKE DRAINAGE PROJECT. O. L. Flanagan. (Can. Engr., May 20, 1915; 5½ pp., illus.) 20c.

1335—GOLDFIELD Re-visited—I and II. T. A. Rickard. (Min. and Sci. Press, May 22 and 29, 1915; 6 pp., illus.) 40c.

1336—RUSSIA—The Elderlinsky Gold Mines. Nicholas T. Truschkoff. (Eng. and Min. Journ., June 12, 1915; 4 pp., illus.) 20c.

IRON AND STEEL METALLURGY

1337—ALLOYS—Iron, Carbon and Phosphorus. J. E. Stead. (Advance copy, Iron and Steel Inst., 1915; 41 pp. and 17 plates, illus.)

1338—ALLOYS—Researches on the Iron, Silicon and Carbon Alloys. Geo. Charpy and Andre Cornu-Thenard. (Advance copy, Iron and Steel Inst., 1915; 31 pp., illus.)

1339—BLAST-FURNACE Plant Auxiliaries and General Arrangement. J. E. Johnson, Jr. (Met. and Chem. Eng., June, 1915; 5½ pp., illus.) 40c.

1340—BURNING—The Detection of Burning in Steel. J. E. Stead. (Advance copy, Iron and Steel Inst., 1915; 5 pp. and 5 plates, illus.)

1341—CORROSION of Iron in Aqueous Solutions of Inorganic Salts. J. Newton Friend and Peter C. Barnet. (Advance copy, Iron and Steel Inst., 1915; 17 pp., illus.)

1342—CORROSION—Protection of Metal Structures. Frederic H. Fay. (Proc. Engrs., Soc. of W. Penn., Mar., 1915; 108 pp., illus.) A 29-page bibliography of metal corrosion and protection is included in this paper. 60c.

1343—CORROSION—The Removal of Rust by Means of Chemical Reagents. J. Newton Friend and C. W. Marshall. (Advance Copy, Iron and Steel Inst., 1915; 7 pp., illus.)

1344—ELECTRIC FURNACE for Reheating, Heat Treating and Annealing. T. F. Baily. (Iro. Eng. Soc. W. Penn., Apr., 1915; 29 pp.) 40c.

1345—ELECTROLYTIC IRON—The Effect of Boron upon the Magnetic and Other Properties of Electrolytic Iron Melted in Vacuo. Trygve D. Yensen. (Bull. 77, Univ. of Ill., Mar. 22, 1915; 19 pp., illus.) 20c.

1346—FLUE-DUST SINTERING PLANT at Gary. (Iron Age, May 27, 1915; 2½ pp., illus.) 20c.

1347—FOUNDRY—Safety in Foundry Operations. Magnus W. Alexander. (Metal Ind., May, 1915; 2 pp.) Paper before joint meeting of Am. Fdymen's Assn. and Am. Inst. of Metals. 20c.

1348—GERMAN "IRIDIUM" Steel. (Can. Engr., May 27, 1915; ¼ p.) 20c.

1349—KILNS—Rotary Sintering Kilns at Gary. H. Cole Estep. (Iron Tr. Rev., May 20, 1915; 3 pp., illus.) 20c.

1350—LOS ANGELES as an Iron and Steel Center. C. Colcock Jones. (Min. and Oil Bull., May, 1915; 6 pp.)

1351—OPENHEARTH FURNACE—The First Openhearth Furnace in Southern California. (Min. and Oil Bull., May, 1915; 1¼ pp., illus.)

1352—PURE IRON—The Manufacture and Use of Pure Iron. Howard See. (Journ. Assn. Eng. Soc., Apr., 1915; 9 pp., illus.) 40c.

1353—SPECIAL STEELS—Brinell Hardness and Tenacity Factors of a Series of Heat-Treated Special Steels. Andrew McWilliam and Ernest Jefferson Barnes. (Advance copy, Iron and Steel Inst., 1915; 10 pp.)

1354—SPECIAL STEELS—The Thermo-Electric Properties of Special Steels. Eugene L. Dupuy and Albert M. Portevin. (Advance copy, Iron and Steel Inst., 1915; 30 pp., illus.)

1355—SULPHIDES IN STEEL INGOTS—Supplementary Notes on the Forms in which Sulphides May Exist in Steel Ingots. J. O. Arnold and G. R. Bolsover. (Advance copy, Iron and Steel Inst., 1915; 6 pp., illus.)

1356—STRESS-STRAIN LOOPS for Steel in the Cyclic State. Prof. J. H. Smith and G. A. Wedgewood. (Advance copy, Iron and Steel Inst., 1915; 33 pp. and 8 plates, illus.)

1357—WAR—The War's Effect on Iron Industry. John Birkinbine. (Iron Tr. Rev., May 27, 1915; 3½ pp., illus.) 20c.

LEAD AND ZINC

1358—ARSENATE OF LEAD—The Valuation of Commercial Arsenate of Lead. R. H. Robinson and H. V. Tartar. (Journ. Ind. and Eng. Chem., June, 1915; 3 pp.)

1359—CAMPBELL PROCESS—Electromagnetic Zinc-Ore Treatment by the Campbell Process. L. E. Ives. (Eng. and Min. Journ., June 5, 1915; 1¼ pp., illus.) 20c.

1360—LEAD POISONING in the Manufacture of Storage Batteries. Alice Hamilton. (Bull. U. S. Bureau of Labor Statistics, Dec. 15, 1914; 38 pp., illus.)

1361—NEW MEXICO—The Hanover Mining District of New Mexico. Faris V. Bush. (Min. and Eng. Wld., May 1, 1915; 3 pp., illus.) 20c.

1362—SPELTER—Analysis of Spelter. (Journ. Ind. and Eng. Chem., June, 1915; 1½ pp.)

1363—WISCONSIN—Mining and Milling of Lead and Zinc Ores in the Wisconsin District, Wisconsin. Clarence A. Wright. (U. S. Bureau of Mines, 1915; 39 pp., illus.) 20c.

OTHER METALS

1364—CARNOTITE—On Carnotite Deposits—and the Rand Banket. Chester T. Kennan. (Min. and Sci. Press, Apr. 17, 1915; 1¾ pp.) 20c.

1365—MONAZITE—Brazilian Monazite Sands Lie in Coastal Strip. Alfred L. M. Gottschalk. (Min. and Eng. Wld., May 15, 1915; 1½ pp.) 20c.

1366—PLATINUM—Occurrence of Platinum at Boss Mine, Nevada. J. C. Kennedy. (Min. and Eng. Wld., May 22, 1915; 2 pp.) 20c.

1367—RADIUM—Practical Methods for the Determination of Radium. I—Interchangeable Electroscope and Its Use. S. C. Lind. (Journ. Ind. and Eng. Chem., May, 1915; 4 pp., illus.) 60c.

1368—RADIUM-URANIUM Ratio in Carnotites. S. C. Lind and C. F. Whittemore. (U. S. Bureau of Mines, 1915; 29 pp., illus.) 20c.

1369—TIN-DRESSING in Bolivia. Harold Allman Lewis. (Min. Mag., May, 1915; 1½ pp.) 40c.

1370—TIN Mining at China Camp, Bloomfield District, Cooktown, 1914. E. Cecil Saint-Smith. (Queensland Govt. Min. Journ., Apr. 15, 1915; 7½ pp., illus.) 40c.

1371—TIN—Mining in the Federated Malay States in 1914. (Min. Journ., May 8, 1915; 2 pp.) 40c.

1372—TIN—The Physical Condition of Cassiterite in Cornish Mill Products. J. J. Beringer. (Bull. 128, I. M. M., May 13, 1915; 34 pp., illus.) 40c.

NONMETALLIC MINERALS

1373—BAUXITE—Occurrence of Bauxite in Central Georgia. Joel H. Watkins. (Min. and Eng. Wld., June 12, 1915; 2 pp., illus.) 20c.

1374—CLAY—Notes on Clay Deposits Near McMurray, Alberta. Sydney C. Ells. (Bull. 10, Can. Dept. of Mines, 1915; 15 pp.)

1375—FULLER'S EARTH — The Production of Fuller's Earth in 1914. Jefferson Middleton. (U. S. Geol. Surv., 6 pp.) 20c.

1376—LIME—Modern Hydrated Lime Plant of the Dutchess County Lime Co. Richard K. Meade. (Journ. Ind. and Eng. Chem., May, 1915; 3½ pp., illus.) 60c.

1377—MEERSCHAUM Deposits of New Mexico. Faris V. Bush. (Eng. and Min. Journ., May 29, 1915; 2½ pp., illus.)

1378—POTASH — Possible Sources of Potash. Chas G. Cresswell. (Journ. Soc. Chem. Ind., Apr. 30, 1915; 6 pp.) 60c.

1379—POTASH Production in Southern California. James T. Armstrong. (Southern Calif. Academy of Sciences, May 19, 1915; 16 pp.)

1380—POTASH SALTS; 1914. W. C. Phalen. (U. S. Geol. Surv., 33 pp., illus.) 20c.

1381—SAPPHIRE MINES of Yogo, Montana. O. W. Freeman. (Min. and Sci. Press, May 22, 1915; 2¼ pp., illus.) 20c.

PETROLEUM AND NATURAL GAS

1382—ALBERTA—Correlation and Geological Structure of the Alberta Oil Fields. D. B. Dowling. (Bull. A. I. M. E., June, 1915; 10 pp., illus.)

1383—ALBERTA—Prospecting Bituminous Sand in Alberta. S. C. Ells. (Can. Min. Journ., May 15, 1915; 3 pp., illus.) From a report issued by the Can. Dept. of Mines. 20c.

1384—DAKOTA SAND—Oil, Gas and Water Content of Dakota Sand in Canada and United States. L. G. Huntley. (Bull. A. I. M. E., June, 1915; 21 pp., illus.)

1385—GASOLINE FROM NATURAL GAS—The Condensation of Gasoline From Natural Gas. Geo. A. Burrell, Frank M. Seibert and G. G. Oberfell. (Bull. 88, U. S. Bureau of Mines, 1915; 106 pp., illus.)

1386—GROSNY PETROLEUM INDUSTRY in 1914. (Petrol. Rev., Apr. 10 and 17, 1915; 2 pp.) 60c.

1387—OIL Refining. Dr. F. E. Knoch. (Journ. of Eng., May, 1915; 7 pp.)

1388 — OIL-WELL Engineering. Wm. Calder. (Petrol. Rev., May 15, 1915; 1¾ pp.) 40c.

1389—PAPUAN OILFIELDS: Extensive Petroleum Deposits. (Petrol. Rev., May 1, 1915; 1¼ pp.) 40c.

1390—ROYALTIES—Sliding Royalties of Oil and Gas Wells. Roswell H. Johnson. (Bull. A. I. M. E., June, 1915; 4 pp.)

1391—RUSSIA—The Russian Petroleum Industry. A Brief Review for the First Quarter of 1915. (Petrol. Rev., May 15, 1915; 1 p.) 40c.

1392—SOUTH AUSTRALIA—The Supposed Oil-Bearing Areas of South Australia. Arthur Wade. (Bull. 4, Geol. Surv. of So. Aust., 1915; 54 pp., illus.)

1393—WYOMING—The Basin and Greybull Oil and Gas Fields, Bighorn County, Wyoming. F. F. Hintze, Jr. (Bull. 10, The State of Wyoming Geologist's Office, 1914; 62 pp., illus.)

ECONOMY GEOLOGY—GENERAL

1394—ALBERTA—Moose Mountain District, Southern Alberta. D. D. Cairnes. (Memoir 61, Can. Geol. Surv., 1914; 62 pp., illus.)

1395—BRITISH COLUMBIA—Physiography of the Beaverdell Map-Area and the Southern Part of the Interior Plateaus of British Columbia. Leopold Reinecke. (Museum Bull. 11, Can. Geol. Surv., Apr. 30, 1915; 58 pp., illus.)

1396—EL ORO—The San Rafael Vein at El Oro. Fergus L. Allen and H. W. Faulkner. (Min. Mag., May, 1915; 4½ pp., illus.)

1397—THE GEOLOGY of Prospects. F. P. Mennell. (Min. Mag., May, 1915; 7 pp., illus.) 40c.

1398—INDIA—General Report of the Geological Survey of India for the Year 1914. C. S. Middlemiss. (Vol. XLV, Part 2, Records of the Geol. Surv. of India, 1915; 53 pp.)

1399—MT. LYELL—The Mt. Lyell Co. and the Complex Ore Problem. Hartwell Conder. (Aust. Min. Stand., Apr. 22, 1915; ¾ p.) 40c.

1400—PETROGRAPHIC—On Certain Points in Petrographic Classification. Whitman Cross. (Amer. Journ. Sci., June, 1915; 5 pp.) 40c.

1401—PLATINUM—A Gold-Platinum-Palladium Lode in Southern Nevada. Adolph Knopf. (Bull. 620-A. U. S. Geol. Surv., Apr. 12, 1915; 18 pp., illus.)

1402—PRE-CAMBRIAN LITERATURE—Summaries of Pre-Cambrian Literature of North America for 1909, 1910, 1911 and Part of 1912. III, Lake Superior Region and Isolated Pre-Cambrian Areas of the Mississippi Valley. Edward Steidtmann. (Journ. of Geol., Apr.-May, 1915; 10½ pp.)

1403—THE OCCURRENCE of Glacial Drift on the Magdalen Islands. James Walter Goldthwait. (Museum Bull. 14, Can. Geol. Surv., May 12, 1915; 11 pp., illus.) 40c.

1404—ORE DEPOSITION—Further Contributed Remarks on "Persistence of Ore in Depth." T. A. Rickard. (Bull. 128, I. M. M., May 13, 1915; 1½ pp.)

1405—SECONDARY ENRICHMENT — Secondary Sulphide Enrichment of Copper Ores. Arthur L. Day. (Min. and Sci. Press, May 29, 1915; 2 pp.) 20c.

MINING—GENERAL

1406—ACCIDENTS—Monthly Statement of Coal-Mine Fatalities in the United States. Albert H. Fay. (U. S. Bureau of Mines, Feb. 1915; 12 pp.) 20c.

1407—ACCIDENTS—Monthly Statement of Coal-Mine Fatalities in the United States. Albert H. Fay. (U. S. Bureau of Mines, Mar., 1915; 12 pp.) 20c.

1408—BUCKET-DUMPING Device. Harold A. Linke. (Eng. and Min. Journ., May 29, 1915; ½ p., illus.) 20c.

1409—CAGES—The North Butte Wing-Bar Design for Cages. (Min. and Eng. Wld., May 29, 1915; ½ p., illus.)

1410—CHUTE—A Simple, Strong Chute. H. H. Hodgkinson. (Eng. and Min. Journ., June 12, 1915; ½ p., illus.) 20c.

1411—ELECTRIC SHOT Firing in Kansas. Clark B. Carpenter. (Coll. Engr., June, 1915; 2½ pp., illus.) 40c.

1412—EXPLOSIVES—Les Explosifs. Henry Le Chatelier. (Rev. de Met., Jan., 1915; 42½ pp., illus.)

1413—EXPLOSIVES—Safety Measures in the Use of Explosives. Wm. Cullen. (Journ. Chem. Met and Min Soc. of So. Afr. Mar., 1915; 7 pp.) 60c.

1414—FIRE-FIGHTING Methods at the Mountain View Mine, Butte, Mont. C. L. Berrien. (Bull. A. I. M. E., June, 1915; 21 pp., illus.)

1415—HAULAGE—Gasoline Locomotive Haulage: Its Cost as Compared to Mule Haulage at Trosper Coal Co. Mines, Kentucky. (Coll. Engr. May, 1915; 1 p., illus.) 40c.

1416—HANDLING ORE at Surface—Ray Con. Copper Mines. C. A. Tupper. (Min. and Eng. Wld., June 5, 1915; 5 pp., illus.) 20c.

1417—HOISTING—The Prevention of Overwinding and Overspeeding in Shafts. G. G. T. Poole. (Iron and Coal Tr. Rev., Apr. 16, 1915; 2¼ pp., illus.) Abstract of paper before No. of Eng. Inst. of Min. and Mechan. Engrs. 40c.

1418—LADDERS—Capital Mine Steel Ladders. Edward S. Wiard. (Eng. and Min. Journ., May 29, 1915; ½ p., illus.) 20c.

1419—MINE HOUSES—Steel and Concrete Mine Houses. (Eng. and Min. Journ., June 5, 1915; 1 p., illus.) 20c.

1420—MINE LIGHTING—Discussing the Efficiency of Mine Lighting. Letson Balliet. (Min. and Eng. Wld., June 5, 1915; 2½ pp., illus.) 20c.

1421—MINE TRACK—North Mine Practice in Underground Points and Crossings. A. G. Campbell. (Proc. Aust. Inst. Min. Engrs., 1915; 8⅓ pp., illus.)

1422—MINING EXCAVATIONS—Cost of Initial Mining Excavations. Eugene D. Gardner. (Journ. Assoc. Eng. Soc., May, 1915; 9¾ pp.) 40c.

1423—MONTANA—The North Moccasin Mountains of Montana. O. W. Freeman. (Min. and Eng. Wld., May 22, 1915; 2¼ pp., illus.) 20c.

1424—MOTHER LODE BLAST. F. S. Norcross, Jr. (Eng. and Min. Journ., May 29, 1915; 4½ pp., illus.) 20c.

1425—NEVADA—History, Production and Geology of Esmeralda District. (Salt Lake Min. Rev., May 30, 1915; 4¼ pp., illus.)

1426—NEVADA—Reconnaissance of Goodsprings District, Nev. J. Nelson Nevius. (Min. and Eng. Wld., May 15, 1915; 2 pp.) 20c.

1427—ROCK DRILLING—The Inefficiency of Rock Drilling. Letson Balliet. (Min. and Eng. Wld., June 12, 1915; 2 pp., illus.) 20c.

1428—PRESSURE VENTILATING System Used in Cripple Creek Mines. S. A. Worcester. (Eng. and Min. Journ., June 5, 1915; 4½ pp., illus.) 20c.

1429—RAY CONSOLIDATED — Underground Mining Systems of Ray Consolidated Copper Co. Lester A. Blackner. (Bull. A. I. M. E., June, 1915; 42 pp., illus.) 40c.

1430—SAFETY RULES—Tentative Mine Safety Rules in California. Lewis H. Eddy. (Eng. and Min. Journ., June 12, 1915; 1⅓ pp.) 20c.

1431—SAND FILLING—Settling Tanks for Hydraulic-Packing Plant. (Coll. Guard., May 21, 1915; ⅔ p., illus.) 40c.

1432—SHAFT LINING—Ferro-Concrete Shaft Linings. M. Gillieaux. (Coll. Engr., June, 1915; 1⅓ pp., illus.) 40c.

1433—SIGNALING—Battery-Bell Signaling Systems and Their Dangers. R. V. Wheeler. (Iron and Coal Tr. Rev., Apr. 23, 1915; 2½ pp., illus.) Report issued by British Home Office. 40c.

1434—SOUTH AUSTRALIA—A Review of Mining Operations in the State of South Australia During Half-Year Ended Dec. 31, 1914; Compiled by Lionel C. E. Gee. (So. Aust. Dept. of Mines, 1915; 35 pp., illus.)

1435—TAMPING—The Efficiency of Tamping. Edgar A. Collins. (Min. and Sci. Press, May 22, 1915; 1 p.) 20c.

1436—TASMANIA—Mining Methods at Mount Lyell, Tasmania. R. M. Murray. (Min. and Eng. Rev., Apr. 5, 1915; 1 p.) Abstract of paper before Austral Inst. of Min. Engrs. 40c.

1437—TOM REED—Activity in Tom Reed-Gold Road District. Wm. P. DeWolf. (Salt Lake Min. Rev., May 15, 1915; 1⅓ pp., illus.) 20c.

1438—TRAM—Timber Carriers for Aërial Tram. Frederick W. Foote. (Eng. and Min. Journ., June 12, 1915; ⅓ p., illus.) 20c.

1439—UTAH—Alta and Cottonwood Mining Districts of Utah. P. H. Cropper. (Min. and Eng. Wld., May 29, 1915; 3¼ pp., illus.) 20c.

1440—UTAH—New Gold Camp of Goldstrike in Washington County. Will C. Higgins. (Salt Lake Min. Rev., May 15, 1915; 5⅞ pp., illus.) 20c.

MINING LAW

1441—TONOPAH—Apex Litigation. Jim Butler v. West End H. V. Winchell. (Min. and Sci. Press, May 15, 1915; 2¾ pp., illus.) 20c.

ORE DRESSING—GENERAL

1442—CONCENTRATING Plant of the Moose Mountain, Ltd. B. B. Hood. (Eng. and Min. Journ., June 5, 1915; 3½ pp., illus.) 20c.

1443—CRUSHING—Author's Reply to Discussion on "Investigations in Ore Milling to Ascertain the Heat Developed in Crushing." (Bull. 128, I. M. M., May 13, 1915; 2¾ pp.) 40c.

1444—FLOTATION—Recent Progress in Flotation. O. C. Ralston and F. F. Cameron. (Eng. and Min. Journ., May 29, 1915; 3½ pp.) 20c.

1445—FLOTATION Tests on Ores from Bisbee and Cobalt. Herbert J. French. (School of Mines Quart., Nov., 1914; 11 pp.) 40c.

1446—OILS—Fett aus Klärschlamm und die Beseitigung der Rückstände. (Chem. Ztg., Apr. 14, 1915; 1½ pp.). Grease from clarifying slimes and the removal of the residues. 40c.

1447—TIMBER BUTTE MILLING CO.—The Concentrator of the Timber Butte Milling Co., Butte, Mont. Theodore Simons. (Bull. A. I. M. E., June, 1915; 22 pp., illus.)

METALLURGY—GENERAL

1448—COAL ASH—The Fusibility of Coal Ash in Various Atmospheres. A. C. Fieldner and A. E. Hall. (Journ. Ind. and Eng. Chem. May and June, 1915; 14 pp., illus.)

1449—COLLOIDS—The Action of Certain Colloids on Ions During Electrolysis. A. Mutscheller. (Met. and Chem. Eng., June, 1915; 4 pp., illus.) 40c.

1450—FURNACE EFFICIENCY—Comparative Furnace Efficiency. R. J. Weitlaner. (Met. and Chem. Eng., June, 1915; 4 pp., illus.) 40c.

1451—LOW-GRADE ORES—Metallurgical Treatment of the Low-Grade and Complex Ores of Utah. D. A. Lyon, R. H. Bradford, S. S. Arentz, O. C. Ralston and C. L. Larson. (U. S. Bureau of Mines, 1915; 40 pp.)

1452—METALLOGRAPHY—The Use of Light Filters with the Tassin Metallographic Apparatus. Frederick H. Getman. (Journ. Ind. and Eng. Chem., May, 1915; ¾ pp., illus.) 60c.

1453—METALLOGRAPHY—De la Metallographie. Henry Le Chatelier. (Rev. de Met., Jan., 1915; 35½ pp., illus.)

1454—REVERBERATORY FURNACE—Notes on the Reverberatory Furnace. Francis R. Pyne. (Met. and Chem. Eng., May, 1915; 1½, illus.) 40c.

1456—SILICA DISHES—Heat Transmission Capacity of a Silica Dish. W. K. Lewis. (Journ. Ind. and Eng. Chem., May, 1915; 5 pp., illus.) 60c.

1457—SMOKE—The Vapor Pressure of Arsenic Trioxide. H. V. Welch and L. H. Duschak. (Tech. Paper 81, U. S. Bureau of Mines, 1915; 21 pp., illus.) 20c.

1458—TEMPERATURE SCALES—Conversion Scale for Centigrade and Fahrenheit Temperatures. Hugh P. Tiemann. (Advance copy, Trans. A. I. M. E., Sept., 1915; 2 pp.) 40c.

1459—SURFACE COMBUSTION—The Application of Surface Combustion. J. H. Ledeboer. (Pro. Aust. Inst. Min. Engrs., 1915; 20 pp., illus.)

1460—THERMAL CONDUCTIVITY—Data on Thermal Conductivity. Boyd Dudley, Jr. (Penn State Min. Quart., Apr. 15, 1915; 13 pp., illus.) 40c.

1461—WHITE ALLOYS—Die-Casting of White Alloys. John C. Work. (School of Mines Quart., Nov., 1914; 2½ pp.) 40c.

MINING AND METALLURGICAL MACHINERY

1462—BEARINGS of Electrical Machinery. Andrew Gibson. (Iron and Coal Tr. Rev., May 7, 1915; 2⅓ pp., illus.). Paper before West of Scotland Branch, Assn. of Min. Elec. Engrs. 40c.

1463—BLOWING PLANT—Modern Gas-Power Blower Stations. Arthur West. (Advance copy, Trans. A. I. M. E., Feb., 1915; 9 pp., illus.) 40c.

1464—DRILL SHARPENER—New Sullivan Drill Sharpener. (Eng. and Min. Journ., May 29, 1915; 1¼ pp., illus.) 20c.

1465—DRILLS and Drill Bit Wrinkles—Record of Experience with Various Types. Chas. A. Hirshberg. (Min. and Eng. Wld., Apr. 24, 1915; 5½ pp., illus.) 20c.

1466—ELECTRIC DEVELOPMENTS on the Pacific Coast. (Elec. Wld., May 29, 1915; 12 pp., illus.) 40c.

1467—ELECTRIC MOTORS—Permissible Explosion-Proof Electric Motors for Mines; Conditions and Requirements for Test and Approval. H. H. Clark. (U. S. Bureau of Mines, 1915; 17 pp., illus.) 20c.

1468—ELECTRICITY—The Use of Electricity in Mining Work. David B. Rushmore. (Gen. Elec. Rev., June, 1915; 13 pp., illus.) 40c.

1469—GAS POWER—Modern Gas-Power Blower Stations. Arthur West. (Bull. A. I. M. E., June, 1915; 9 pp., illus.)

1470—GRANITE MOUNTAIN HOIST—Features of the Electrical Equipment for the Granite Mountain Hoist. G. B. Rosenblatt. (Journ. Assoc. Eng. Soc., May, 1915; 10¼ pp., illus.) 40c.

1471—HOIST—Fleeting Device for Hoist with Conical Drums. F. H. Armstrong. (Eng. and Min. Journ., May 29, 1915; ½ p., illus.) 20c.

1472—HOIST—The New Electric Hoist of the North Butte Mining Co. G. B. Rosenblatt. (Salt Lake Min. Rev., Apr. 30, 1915; 3¼ pp., illus.) 20c.

1473—POWER CURVES—Hoist and Compressor Power Curves. P. E. Barbour. (Eng. and Min. Journ., June 5, 1915; ¾ p., illus.) 20c.

1474—PUMPS—Efficiencies of Mine Pumps. P. E. Barbour. (Eng. and Min. Journ., June 12, 1915; 1 p.) 20c.

1474a—ROD CASTING—The Mellen Rod-Casting Machine. R. C. Patterson, Jr. (Bull. A. I. M. E., May, 1915; 6¼ pp., illus.) 40c.

1475—SHOVELING MACHINE—Halby Shoveling Machine for Underground Mining. (Eng. and Min. Journ., May 29, 1915; ¾ p., illus.) 20c.

1476—STEAM SHOVEL—A Large Steam Shovel at Limestone Quarry, Aberthaw & Bristol Channel Portland Cement Co. (Engineer, Apr. 9, 1915; 1 p., illus.) 40c.

1477—STEAM TURBINES—Small Steam Turbines at Coal-Mine Power Plants. R. M. Rush. (Coal Age, May 29, 1915; 2¼ pp., illus.) 20c.

1478—RAND—The Use of Compressed Air on the Rand. (Coll. Guard., May 21, 1915; ⅝ p.)

SAMPLING AND ASSAYING

1479—BATTERY Assay of Copper. (Journ. Ind. and Eng. Chem., June, 1915; 1½ pp.) 60c.

1480—BRASS—Ueber Messinganalyse. Koch. (Chem.-Ztg., Mar. 20, 1915; 1 p.) On the analysis of brass. 40c.

1481—COKE ASH—The Effect of Different Methods of Crushing on the Ash of Coke. F. A. Eastaugh. (Bull. 128, I. M. M., May 13, 1915; 3 pp.) 40c.

1482—COKE—Metallic Iron in Coke Samples as a Cause of Discrepancy between Actual and Theoretical Coke Ash. J. R. Campbell. (Coll. Engr., May, 1915; 3 pp.) 40c.

1483—IODOMETRIC TITRATIONS—Ueber Nachfärbungen bei jodometrischen Titrationen. Kolb. (Chem.-Ztg., Apr. 17, 1915; 1 p.) On after-colors in iodometric titrations. 40c.

1484—LITHARGE—Edelmetalle in Bleiglätte. Loevy. (Chem.-Ztg., Apr. 14, 1915; ½ p.) Precious metals in litharge. 40c.

1485—THE SEPARATION of Magnesium from Lithium by Means of Ammonium Carbonate in Alcoholic Solution. J. Gray Dinwiddie. (Amer. Journ. Sci., June, 1915; 2½ pp.)

INDUSTRIAL CHEMISTRY

1486—EUROPEAN WAR—Discussion on the Bearing of the Present War Crisis on the Chemical Industries of the East of Scotland. (Journ. Soc. Chem. Ind., Apr. 15, 1915; 2¼ pp.) 60c.

1487—EUROPEAN WAR—Die Chemische Industrie Schweden's und der Krieg. Larson. (Chem.-Ztg., Apr. 3, 1915; 1¾ pp.) Sweden's chemical industry and the war. 40c.

1488—WORKMEN—Das Lebensalter der Arbeiter in der chemischen Industrie. Badermann. (Zeit. f. angew. Chem., Mar. 9, 1915; 1¾ pp.) The life of the workmen in the chemical industry. 40c.

MATERIAL OF CONSTRUCTION

1489—CEMENT—Magnesia Cement. C. H. B. Burlton. (Engineer, May 14, 1915; 1⅓ pp.) 40c.

1490—COLORADO BUILDING STONES—Tests of Colorado Building Stones. Milo S. Ketchum. (Journ. Eng., May, 1915; 7 pp.)

1491—PORTLAND CEMENT—British Portland Cement Making Machinery, XI and XII (Engineer, May 14 and 21, 1915; 5 pp., illus.) 80c.

1492—PORTLAND CEMENT—The Case for the Electrification of Portland Cement Works. Ernest P. Hollis. (Elec. Rev., London, Apr. 16, 1915; 2½ pp., illus.) 40c.

1493—PORTLAND CEMENT—Some Mechanical Features of the Hydration of Portland Cement and the Making of Concrete as Revealed by Microscopic Study. Nathan C. Johnson. (Advance copy, A. S. M. E., June, 1915; 47 pp., illus.)

MISCELLANEOUS

1494—GERMANY—Coal Scarce in Germany. (Eng. and Min. Journ., May 29, 1915; ⅓ p.)

1495—HYDRO-ELECTRIC POWER—Notes on Lake Margaret (Tasmania) Hydro-Electric Power Scheme. Geo. W. Wright. (Pro. Aust. Inst. Min. Engrs., 1915; 7 pp.)

1496—PROGRESS IN CHEMISTRY—Experimentelle anorganische Chemie und Elektrochemie im Jahre, 1914. Guthier. (Zeit. f. angew. Chem., Mar. 2, 9, 16, 23, 30 and Apr. 6, 1915; 72 pp.) Experimental inorganic chemistry and electrochemistry in 1914.

1497—MELLON INSTITUTE—The Object and Work of the Mellon Institute. Raymond F. Bacon. (Journ. Ind. and Eng. Chem., Apr., 1915; 4⅝ pp.) 60c.

1498—MELLON INSTITUTE OF INDUSTRIAL RESEARCH—Description of the New Building of the Mellon Institute. W. A. Hamor. (Journ. Ind. and Eng. Chem., Apr., 1915; 9½ pp., illus.) 60c.

1499—METAL PRICES—Le Mouvement Economique des Métaux Autres que le Fer en 1912 et 1913. M. Rebeyrol. (Rev. de Met., Dec., 1914; 14½ pp.)

1500—ORE-CARRYING VESSELS—The Influence of Discharging Appliances on the Design of Large Ore-Carriers. John Reid. (Engineering, Mar. 26, 1915; 3 pp., illus.) Paper before Brit. Instn. of Naval Architects. 40c.

1501—POWER—The Hydro-Electric Development of the Peninsular Power Co. Chas. V. Seastone. (Bull. A. I. M. E., Feb., 1915; 21½ pp., illus.)

1502—PROHIBITION—The Alcohol Question on the Rand. (So. Afr. Min. Journ., Jan. 30, 1915; 1¼ pp.) Memorandum on alcohol question as it relates to industries by Dr. A. J. Orenstein, Supt. of Sanitation to the Rand Mines, Ltd. 40c.

1503—RUSSIA—In and Out of the Caucasus in War Time. Leonard C. David. (Eng. and Min. Journ., Mar. 13, 1915; 3¼ pp., illus.) An account of the attack by the Turks in November, 1914, and the flight from Batoum to London. 20c.